# Eighteenth Report of the Ontario Bureau of Mines

1909

# EIGHTEENTH ANNUAL REPORT

OF THE

# BUREAU OF MINES, 1909

## VOL. XVIII, PART I.

CONTENTS


| | |
|---|---|
| STATISTICAL REVIEW | 5-78 |
| MINES OF ONTARIO | 79-140 |
| IRON RANGES OF NIPIGON DISTRICT | 141-153 |
| IRON RANGE NORTH OF ROUND LAKE | 154-162 |
| BLACK STURGEON IRON REGION | 163-179 |
| BOG IRON ON ENGLISH RIVER | 180-195 |
| GEOLOGY OF ONAMAN IRON RANGE AREA | 196-253 |
| IRON FORMATION OF WOMAN RIVER AREA | 254-262 |
| LAKE ABITIBI AREA | 263-283 |
| LAKE OJIBWAY; LAST OF THE GREAT GLACIAL LAKES | 284-293 |
| CLASSIFICATION AND NOMENCLATURE OF ONTARIO DRIFT | 294-297 |


PRINTED BY ORDER OF THE LEGISLATIVE ASSEMBLY OF ONTARIO.


TORONTO
Printed and Published by L. K. CAMERON, Printer to the King's Most Excellent Majesty
1909

WARWICK BROS' & RUTTER, Limited, Printers,
TORONTO.

# CONTENTS


PAGE.

Letter of Transmission ... 1

Introductory Letter ... 2

Statistical Review ... 5-78
- Mineral production of Ontario 1908 ... 5
- Comparative value mineral production, 1907 and 1908 ... 6
- Basis of statistical values ... 7
- Value mineral production, 1908, "Geological Survey" basis ... 8
- Mineral production, 1904 to 1908 ... 8
  - Gold ... 9
  - Silver ... 9
    - The producing mines ... 10
    - Silver production, Cobalt mines, 1904 to 1908 ... 11
    - Total silver production of Ontario ... 11
    - Refining plants and concentrators ... 12
    - Ore purchasers ... 13
    - Arsenic, nickel, cobalt ... 13
    - Labor employed ... 13
    - Total production Cobalt mines, 1904 to 1908 ... 15
    - Tonnage of ore produced ... 15
    - Dividend-paying mines ... 16
    - New silver fields ... 16
    - Means of communication ... 16
    - Statement of dividends paid by silver-cobalt mining companies ... 17
    - Mining in a forest reserve ... 19
  - Nickel ... 19
    - Monel metal ... 21
    - Nickel-copper mining, 1904 to 1908 ... 23
    - A new nickel area ... 23
  - Copper ... 25
  - Iron ore ... 25
  - Pig iron and steel ... 25
    - Production iron and steel, 1904 to 1908 ... 27
  - Materials of construction ... 27
    - Brick ... 27
    - Drain tile and sewer pipe ... 29
    - Lime and stone ... 29
    - Portland cement ... 29
    - Production of cement, 1891 to 1908 ... 30
    - Prices of Portland cement ... 30
  - Pottery ... 31
  - Arsenic ... 31
  - Iron pyrites ... 32
    - Production of iron pyrites, 1904 to 1908 ... 32
  - Mica ... 32
  - Salt ... 33

Statistical Review.—*Continued.* PAGE.
- Petroleum ... 33
  - Petroleum prices and products ... 35
  - Petroleum and petroleum products, 1904 to 1908 ... 35
- Natural gas ... 35
  - Natural gas production, 1904 to 1908 ... 36
  - Use and advantages of natural gas ... 36
  - Plugging abandoned gas and oil wells ... 36
- Minor products ... 37
- Revenue for the year ... 38
  - Mining lands ... 38
  - Mining lands sold and leased in 1908 ... 38
  - Licenses, permits and recording fees ... 39
  - Mining royalties ... 39
  - Revenue under Supplementary Revenue Act ... 40
  - Receipts from Provincial mine ... 42
- Mining companies incorporated in 1908 ... 43
- Mining companies licensed in 1908 ... 45
- The mining divisions ... 46
  - The improved mining law ... 46
  - List of mining divisions ... 47
  - Territory added to Montreal River mining division ... 47
  - Gowganda mining division ... 47
  - Kenora ... 48
  - Port Arthur ... 48
  - Sault Ste. Marie ... 49
  - Sudbury ... 49
  - Montreal River ... 49
  - Temiskaming ... 49
  - Coleman ... 50
  - Larder Lake ... 50
  - Parry Sound ... 50
- The Government diamond drills. 50
- Provincial assay office ... 52
  - Work for Bureau of Mines ... 53
  - Work for the public ... 53
  - Assays and analyses made ... 53
  - Methods of analysis ... 53
  - Notes ... 54
- Mining accidents ... 54
  - Canadian Copper company ... 54
  - Helen iron mine ... 57
  - Mond Nickel company ... 58
  - Beaver Consolidated mines ... 59
  - The Buffalo mine ... 59
  - City of Cobalt Mining company ... 60
  - Columbus Cobalt Silver company ... 60

| | PAGE. |
|---|---|
| STATISTICAL REVIEW.—*Continued.* | |
| Crown Reserve Mining company | 61 |
| Drummond Mines | 61 |
| French-Greensmith prospect | 61 |
| Mining claim No. 223 | 61 |
| Grey's Siding Development Company | 61 |
| Keeley Mine | 61 |
| Kerr Lake Mining Company | 61 |
| La Rose mine | 62 |
| Nancy-Helen mine | 62 |
| Nipissing Mining Company | 63 |
| Northland Mining Company | 65 |
| Nova Scotia mine | 65 |
| O'Brien mine | 65 |
| Paterson mine | 66 |
| Right-of-Way Mining Company | 66 |
| St. Lawrence-Cobalt Mining Company | 66 |
| Temagami Gold Reefs Company | 67 |
| Temagami Mining and Milling Company | 67 |
| Trethewey Silver-Cobalt mine | 67 |
| Victoria Silver-Cobalt mine | 68 |
| Wilbur iron mine | 68 |
| Kingston Feldspar and Mining Company | 68 |
| Table of mining accidents in 1908 | 69 |
| Mine accidents, by E. T. Corkill | 71-78 |
| Causes of accidents | 72 |
| Accidents from falls of ground | 74 |
| Shaft accidents | 74 |
| Accidents from explosives | 76 |
| Conclusion | 77 |
| MINES OF ONTARIO | 79-140 |
| I. Northwestern Ontario | 79 |
| Upper Manitou Lake area | 79 |
| Laurentian gold mine | 79 |
| Paymaster gold mine | 79 |
| Detola gold mine | 81 |
| Victory gold mine | 81 |
| Minnehaha gold mine | 81 |
| Lake of the Woods district | 81 |
| Sturgeon lake | 81 |
| Vermilion pyrite mine | 83 |
| Atikokan Iron Company | 84 |
| Port Arthur silver mines | 84 |
| Beaver mine | 84 |
| II. Sudbury and the North Shore | 84 |
| Gold | 85 |
| Havilah mine | 85 |
| Canadian Exploration Company | 85 |
| Canadian Copper Company | 86 |
| Creighton mine | 86 |
| Quartz mine | 86 |
| Cobalt refining plant | 86 |
| Nickel-Copper smelting plant | 86 |
| Crean Hill mine | 86 |
| Mond Nickel Company | 87 |
| Victoria mine | 88 |

| | PAGE. |
|---|---|
| MINES OF ONTARIO.—*Continued.* | |
| Garson mine | 88 |
| Worthington nickel mine | 89 |
| Whistle nickel property | 89 |
| Copper | 89 |
| Bruce mines | 89 |
| Hermina mine | 89 |
| Moose Mountain iron mine | 89 |
| Michipicoten region | 90 |
| Helen iron mine | 90 |
| Grace gold mine | 91 |
| Golden Reed claims | 91 |
| Blueberry claims | 92 |
| Norwalk mine | 92 |
| Algoma Power Company | 92 |
| III. Temiskaming | 94 |
| Cobalt and vicinity | 94 |
| Montreal River | 95 |
| Miller, Everett and Gowganda | 95 |
| Larder Lake | 96 |
| Cobalt silver mines | 96 |
| Argentite | 96 |
| Badger | 96 |
| Beaver | 96 |
| Bailey | 98 |
| Buffalo | 98 |
| Casey Cobalt | 99 |
| City of Cobalt | 99 |
| Coniagas | 99 |
| Cobalt Central | 100 |
| Chambers-Ferland | 101 |
| Crown Reserve | 101 |
| Coleman Development | 103 |
| Columbus | 103 |
| Cobalt Lake | 104 |
| Cobalt Town Site | 104 |
| Colonial | 104 |
| Century | 104 |
| Canuck | 104 |
| Drummond | 105 |
| Davis Fraction | 105 |
| Floyd | 105 |
| Farah | 105 |
| Foster | 105 |
| Green-Meehan | 105 |
| Gould Consolidated | 106 |
| Hargrave | 106 |
| Kerr Lake | 107 |
| Kerr Lake Majestic | 107 |
| Kerry lease | 107 |
| King Edward | 107 |
| La Rose | 108 |
| Little Nipissing | 109 |
| Little Nipissing lease | 109 |
| McKinley-Darragh | 109 |
| Red Jacket (Morrison) | 111 |
| Northern Customs concentrator | 111 |
| Nancy-Helen mine | 111 |
| Nipissing | 111 |
| Nova Scotia | 113 |
| Nugget claim | 114 |
| O'Brien mine | 114 |
| Ore Reduction Company | 115 |
| Peterson Lake | 115 |
| Provincial mine | 115 |

PAGE.

Mines of Ontario.—*Continued.*
Princess ... 115
Pontiac ... 115
Paterson ... 115
Progress ... 115
Queen Alexandra ... 116
Right of Way ... 116
Rochester ... 116
Savage ... 117
Silver Bar ... 117
Silver Queen ... 117
Scott lease ... 118
Silver Cliff ... 118
St. Anthony lease ... 119
Shamrock ... 119
Silver Leaf ... 119
Strathcona ... 119
Silver Cross ... 119
Susquehanna lease ... 119
Temiskaming and Hudson Bay ... 120
Trethewey ... 120
Trinity ... 121
Union Pacific lease ... 121
University ... 121
Temiskaming ... 121
Victoria ... 122
Violet ... 122
White prospect ... 122
South Lorrain ... 123
Bousquet claim ... 123
Haileybury Silver mine ... 123
Harris-Lorrain syndicate ... 123
H. R. 24 ... 123
Keeley mine ... 123
Maidens Silver Mining Company ... 124
Proudfoot fraction ... 124
Wettlaufer ... 124
Woods ... 125
Wiltsey ... 125
Elk Lake area ... 125
Devlin ... 125
Cragg ... 125
Elk Lake Discovery ... 125
Elk Lake Silver Cobalt ... 126
Gavin-Hamilton ... 126
Langham ... 126
Lucky Godfrey ... 126
McFadden ... 126
Mother Lode ... 126
Moose Horn ... 126
Otisse ... 127
Otisse-Curry ... 127
Otisse claim near Hubert lake ... 127
Maple Mountain area ... 128
Foster ... 128
Stevenson ... 128
Darby ... 128
Gowganda and Miller Lake area ... 128
Larder Lake ... 128
Harris-Maxwell ... 128
Larder Lake Proprietary ... 130

PAGE.

Mines of Ontario.—*Continued.*
Reddick ... 130
Gold King ... 130
Richardson ... 132
H. S. 109 ... 132
Big Pete Canadian Mines ... 132
Craig ... 132
Temagami area ... 132
Northland ... 132
Sterling ... 132
Temagami Gold Reefs Company ... 133
Temagami Cobalt ... 133
IV. Eastern Ontario ... 133
Gold ... 133
Gilmour ... 133
Iron ... 133
Mayo ... 133
Rankin property ... 134
Zinc ... 134
Richardson or Olden mine ... 134
Vankleek ... 135
Iron pyrites ... 135
Hungerford or Sulphide mine 135
Craig ... 136
Canadian Pyrite Syndicate ... 136
Feldspar ... 136
Richardson mine ... 137
Graphite ... 137
McConnell ... 137
Black Donald ... 139
Talc ... 139
Mica ... 139
Hanlan ... 139
Lacey ... 140
Silver Queen ... 140
Mica prospects ... 140
Mica Trimming works ... 140
Corundum ... 140

Iron Ranges of Nipigon District 141-153
Routes to Little Long Lake ... 141
Long lake ... 142
Long lake to Little Long lake ... 146
Little Long lake ... 146
Iron claims on Little Long lake. 146
Iron claims west of Little Long lake ... 148
Northern end of Long lake ... 149
Pic river ... 149

Iron Range North of Round Lake ... 154-162
Introduction ... 154
Mud river between Nipigon and Round lakes ... 155
Rocks of the Round lake district 157
Keewatin greenstones and green schists ... 157
The Iron formation ... 158
The Laurentian granite and gneiss ... 159
The Keweenawan diabases ... 159
Pleistocene geology ... 160
"Haystack Mountain" ... 162

PAGE.

Black Sturgeon Iron Region ...163-179
- The Black Sturgeon river ........... 163
- Nonwatin lake ........................ 164
- Geology of the Nonwatin region ... 165
- Along Black Sturgeon river ......... 166
- Iron locations between Nonwatin and Sturgeon lakes ................ 168
- Locations southeast of Black Sturgeon lake .. ......................... 170
  - Location 94 E ........................ 170
  - 95 E and 96 E ........................ 172
- Summary of the geology .............. 173
- The Fraser Lake region .............. 175
- Black Sturgeon lake .. ............... 176
- Black Sturgeon bay to South bay. 177

Bog Iron on English River ......180-195
- Introduction ............................ 180
- Distribution of the bog ore ......... 180
- Rocks of the district .................. 183
- Physiographic history of the district ...................................... 184
- Descriptions of the deposits ......... 185
  - How the iron occurs ............... 185
  - Concretionary discs of ore ......... 186
  - Extent of the deposits ............ 188
  - Little Bear lakes ..................... 188
  - Hematite lake ......................... 190
- Origin of the bog iron ............... 191
- How water carries the iron ......... 191
- Solvents for the iron .................. 193
- Precipitation of iron in the bog ... 193
- Bog iron elsewhere in Canada ...... 194
- Economic possibilities of English River region .......................... 195

Geology of Onaman Iron Range Area ..................................196-226
- I. Introduction .......................... 196
- II. History of the district ......... 196
- III. Geography .......................... 198
  - Position and extent of the district ...................................... 198
  - Climate, soil and vegetation ... 200
  - Fish and game ........................ 200
  - Surveys ................................. 201
- IV. Physiography ...................... 202
  - Topography ............................ 202
  - Drainage ............................... 204
- V. Geology ................................ 204
  - Outline of the historical geology. 204
  - Structure ............................... 208
    - Metamorphism ..................... 212
  - The rock formations in detail ... 218
    - The greenstones and green schists (basic rocks) ......... 218
    - Petrography of the basic rocks 219
    - Rhyolites and rhyolite porphyries or quartz porphyries (acid rocks) ....................... 220
    - Petrography of the acid eruptives ................................ 223
    - Rhyolite .............................. 224
    - Tourmaline-bearing rhyolite ... 225

PAGE.

Geology of Onaman Iron Range Area.—*Continued.*
- Rhyolite-porphyry or quartz-porphyry ......................... 225
- Rhyolite-tuffs, agglomerates and conglomerates ............ 226
- Petrography of the tuffs, agglomerates and conglomerates ................................ 229
- The iron formation ............... 231
- Petrography of the iron formation .............................. 233
- The slates ............................ 234
- The graywackés ................. 235
- The ferruginous cherts ......... 236
- Genesis of the iron formation 239
- Origin of the banding .......... 241
- Economic possibilities of the Onaman district ............... 243
- The Laurentian granite and gneiss .............................. 246
- Huronian hornblende-porphyry 246
- Diorite dikes ....................... 246
- Keweenawan diabase ............ 247
- Pleistocene deposits ............. 250
- A recent deposit: travertine. 252
- Summary ........................... 252

Iron Formation of Woman River Area ........................... .... 254-262
- Situation of the range ............... 254
- Geology and structure of the range 255
  - The basal greenstones ............... 255
  - The iron formation .................. 255
  - The volcanic breccia ............... 259
  - The iron formation and the associated igneous rocks ............ 269
  - Igneous origin of iron formation 261

Lake Abitibi Area .....................263-283
- Route of access .......................... 263
- Topography of the area ............... 266
- Soil and timber ........................ 267
- Gold ......................................... 268
- Geology .................................... 271
  - Keewatin ............................... 272
  - Chrome iron ore in Keewatin ... 273
  - Keewatin sediments ................ 275
  - Laurentian .............................. 278
  - Lower Huronian ..................... 279
  - Post-middle Huronian ............ 280
  - Glacial .................................. 281

Lake Ojibway: Last of the Great Glacial Lakes .....................284-293
- Introduction ............................. 284
- Lake Algonquin and region north of watershed ....................... 286
- Deposits formed in lake Ojibway ... 288
- The Abitibi region ..................... 288
- Lake deposits on T. & N. O. railway ...................................... 289
- Drift near Long lake ................. 290

PAGE.
LAKE OJIBWAY: LAST OF THE GREAT GLACIAL LAKES.—*Continued.*
Size of lake Ojibway and character of its shores ..... 292
Outlets of the lake ..... 292
Limits of marine submergence ..... 293
CLASSIFICATION AND NOMENCLATURE OF ONTARIO DRIFT ..... 294-297
Pleistocene history of the region ... 295
Glacial and interglacial periods. 295
Glacial and post-glacial lakes ... 295
Nomenclature and correlation of Pleistocene deposits ..... 296
Classification ..... 297

# ILLUSTRATIONS

PAGE.
Location stakes in the forest ..... 14
Gowganda, February, 1909 ..... 14
Stopping-place, 10 miles east of Gowganda, early in 1909 ..... 18
Insley's stopping-place, road to Gowganda, winter, 1908-9 ..... 18
Indian prospectors, winter ..... 20
Burwash, on Sellwood-Gowganda winter road ..... 20
Windsor hotel, Gowganda, February, 1909 ..... 21
Hotel, Gowganda, February, 1909 ..... 21
Saw-mill, Gowganda, February, 1909 ..... 22
Main street, Gowganda, February, 1909 ..... 22
Hotel in process of construction, Gowganda, February, 1909 ..... 26
Indian family, Indian Chute, Montreal river ..... 26
Elkhorn, Gowganda district ..... 28
Building a house at Elkhorn ..... 28
The "Berry" safety catch, for crosshead guide of sinking bucket ..... 75
Laurentian gold mine ..... 80
Detola gold mine ..... 80
Cut 72 feet deep, Grand Trunk Pacific railway, near Vermilion pyrite mine..... 82
Vermilion pyrite mine, Northern Pyrites Company ..... 83
Creighton nickel-copper mine, showing buildings and partial view of open cut..... 85
Crean Hill nickel-copper mine ..... 87
Helen iron mine ..... 90
Stamp mill, Grace gold mine ..... 91
Golden Reed stamp mill ..... 92
Stamp mill, Norwalk gold mine ..... 93
Power development at High Falls, Michipicoten river ..... 93
North end Cobalt lake, showing Right-of-Way mine, etc. ..... 97
Crown Reserve silver mine, showing exposed bed of Kerr lake ..... 101
Kerr lake, showing Drummond and other mines ..... 102
Foster Cobalt silver mine ..... 106
McKinley-Darragh silver mine, Cobalt lake in foreground..... 110
Northern Customs Concentrator, Cobalt ..... 111
Nova Scotia silver mine ..... 113
Cobalt Silver Queen mine ..... 117
Silver Cliff and King Edward silver mines ..... 118
Temiskaming and Hudson Bay silver mine ..... 120
Temiskaming silver mine ..... 122
Keeley silver mine, South Lorrain ..... 124
Otisse silver mine, Silver lake ..... 127
Stamp mill, Harris-Maxwell gold mine, Larder lake..... 129
Open cut, Harris-Maxwell gold mine ..... 129
Larder Lake Proprietary Company's stamp mill, Larder lake..... 131
Dr. Reddick Company's stamp mill, Larder lake ..... 131
Mayo iron mine, Bessemer ..... 134
Surface showing of magnetite at Coe and Rankin's mine ..... 135
Gillespie pyrite mine, near Queensboro ..... 136
Talc mill, Madoc ..... 137
Globe Refining Company's graphite mill, Port Elmsley ..... 138
Globe Refining Company's graphite mine ..... 138
High Falls of Kenogami river ..... 143
Hudson's Bay Company's post, Long lake ..... 143
"Husky" dogs, Hudson's Bay Company's post, Long lake ..... 145

PAGE.
Creek navigation between Little Long lake and Long lake .... 145
Map showing iron claims west of Little Long lake .... 147
Cultivating clay belt, Long lake. .... 149
Clay bank, Pic river .... 150
Pic river below falls .... 150
Falls at Lake Superior portage, Pic river .... 151
Sandhill falls, Pic river .... 151
Gneiss, Lake Superior portage, Pic river .... 152
Stratified glacial clay, Mud river, below Long portage ... 152
First falls on Mud river .... 154
Map showing position of iron range north of Round lake .... 156
Transporting materials for Transcontinental railway .... 158
A column of diabase, Lake Nipigon .... 160
"Haystack Mountain," from lake Nipigon .... 161
View showing fractured condition of "Haystack Mountain" on southeast side ... 161
Diabase cliffs, Black Sturgeon river .... 164
Laurentian hills, Black Sturgeon river .... 167
Canyon near Black Sturgeon river .... 167
Cliff in canyon near Black Sturgeon river .... 169
Indian children, Height of Land portage, Pic river .... 171
Indian mother with pappoose .... 173
Jackfish, the largest 2 feet 11 inches long .... 176
Bear cubs at Indian camp, Nipigon river .... 178
Map of mining claims on Little Bear lakes .... 181
Map of mining claims near Niblock station .... 182
Bog iron ore below a layer of soil, near Niblock station .... 185
Bog iron ore concretions from Hematite lake .... 187
Bog iron ore concretions from Little Bear lakes .... 189
Bog iron ore concretions, shore of Hematite lake .... 190
Sketch map showing position of Onaman iron range area .... 197
Prospectors' camp on the southern iron range.... 198
Geological party crossing lake Nipigon by canoe .... 199
Typical brulé, southern iron range .... 201
Kettle lake and regular outline of Keewatin hills .... 202
Kettle lake in terminal moraine on Johnson creek .... 203
Agglomerate at the twelfth portage on the Red Paint river.... 206
Folding and fracturing in the iron formation of the southern range .... 209
Sketch illustrating thickening and thinning of beds in iron formation .... 210
Sketch illustrating effects of longitudinal thrusts on jasper bands in slate.... 213
Sketch showing autoclastic fragment of jasper developed by rolling and pinching. 214
Sketch of ellipsoidal or pillow structure in greenstone .... 220
Plate I.—Fig. 1. Photograph showing minor folds developed in a banded slate. Fig. 2. Photograph showing minor faults in a carborate slate. Fig. 3. Photomicrograph showing fracture cleavage in jasper.... 221
Contact between iron formation and agglomerate on the southern range .... 222
Tuff and agglomerate, Johnson creek .... 226
Pebbles from the conglomerate tuff on the Miller claims .... 227
Tuff and agglomerate from the north side of the iron formation on the southern range .... 229
Banded jasper and slate from the lake Wendigokan district .... 234
Outcrop of iron formation rising above the swamp on the southern range .... 236
Plate II.—Fig. 1. Photomicrograph showing fracture cleavage in a hematite slate. Fig. 2. Photomicrograph showing magnetite crystals in a jasper. Fig. 3. Photomicrograph of thin section similar to Fig. 2.... 237
Plate III.—Fig. 1. Photomicrograph of actinolite quartz schist. Fig. 2. Photomicrograph of dumortierite in jasper. Fig. 3. Photomicrograph showing tourmaline in rhyolite .... 242
Rhyolite dipping under an outcrop of iron formation .... 244
Diamond drill at work on the Winter camp claims .... 245
Diorite dike cutting jasper on Height of Land claims on the northern iron range. 247
Plate IV.—Fig. 1. Photograph showing a banded cherty iron carbonate. Fig. 2. Photomicrograph showing re-absorption of a microcline crystal by the matrix. Fig. 3. Photomicrograph of thin section showing the re-absorptive action of the matrix of a rhyolite porphyry on the quartz phenocrysts .... 248
Dry kettle in terminal moraine along Johnson creek .... 250
Kettle lake in terminal moraine along Johnson creek.... 251

PAGE.
Cherty iron carbonate rock from claim W.S. 6 ..... 256
Hematitic-magnetitic-siderite chert ..... 256
Ferruginous chert ..... 257
Ampibolitic-magnetitic chert ..... 258
Hematitic-pyritic-sideritic chert ..... 259
On the Abitibi river ..... 263
Characteristic shore of Abitibi ..... 265
Raft of logs on Abitibi ..... 267
Stringers of quartz in dolomite ..... 268
On Shaft island ..... 269
Quartz stringers in rusty-weathering dolomite ..... 271
Jaspilite on Abitibi ..... 275
Residual boulders from glacial deposits ..... 281
On Abitibi waters ..... 282
Lake Ojibway: last of the great glacial lakes ..... 285

## MAPS

Preliminary map of the Woman River Iron Range, after p. 253.
Map of the Onaman Iron Range, to accompany report on Iron Ranges, east of Lake Nipigon, by E. S. Moore; geologically colored. Scale 2 inches—1 mile.
Map of the Lake Abitibi Area, District of Nipissing, to accompany report of M. B. Baker; geologically colored. Scale, 2 miles—1 inch.

## LETTER OF TRANSMISSION

To His Honour John Morison Gibson, Etc., Etc., Etc.,

*Lieutenant-Governor of the Province of Ontario*:

Sir,—I have the honour to transmit herewith for presentation to the Legislative Assembly of the Province of Ontario, the Eighteenth Annual Report of the Bureau of Mines.

I have the honour to be, Sir,
Your obedient servant,

F. Cochrane,
*Minister of Lands, Forests and Mines.*

Department of Lands, Forests and Mines,
Toronto, 25th March, 1909.

# INTRODUCTORY LETTER

To THE HONOURABLE FRANK COCHRANE,
*Minister of Lands, Forests and Mines*:

SIR,—I beg to hand you herewith for presentation to His Honour the Lieutenant-Governor in Council the Eighteenth Annual Report of the Bureau of Mines, consisting of two Parts.

Part I. presents the usual summary review of the mining industry of the Province, with statistical tables showing the quantity and value of the output of minerals and mineral products, and other information bearing upon the progress and development of the industry. It deals also with the work performed at the Provincial Assay Office, Belleville, the operation of the Government Diamond Drills, mining accidents, the administration of the mining law and the disposal of the mining lands of the Crown, Mining Recorders and Mining Divisions, the collection of mining revenue, etc.

For a number of years the Bureau has been endeavoring to work out the known Iron Ranges of northern and northwestern Ontario, and has presented annually the results obtained by its geologists and explorers. This series of reports is continued in Part I. of the present volume under the following titles:—Iron Ranges of Nipigon District, and Black Sturgeon Iron Region, by Dr. A. P. Coleman; Iron Range North of Round Lake, and Bog Iron on English River, by E. S. Moore; and Iron Formation of Woman River Area, by R. C. Allen, instructor in geology in the University of Michigan, to whom the thanks of the Bureau are due for permission to publish the results of his work carried on for other parties. There is also a study in detail of the geology of the Onaman Iron Range Area, by Mr. Moore.

Mr. M. B. Baker headed an exploration party into the region adjacent to Lake Abitibi, and gives an account of his observations under the heading "The Abitibi Area."

Lastly, Dr. A. P. Coleman, who has long made a specialty of the glacial phenomena of Ontario, gives a description of Lake Ojibway, the Last of the Great Glacial Lakes, and presents his views on the Classification and Nomenclature of the Drift of Ontario.

Part II., published separately, contains the reports of A. G. Burrows on the Silver Regions of South Lorrain and Lake Gowganda, accompanying which are geologically coloured maps of the former and a portion of the latter area.

I have the honour to be, Sir,
Your obedient servant,

THOS. W. GIBSON,
*Deputy Minister of Mines.*

OFFICE OF THE BUREAU OF MINES,
Toronto, 25th March, 1909.

# REPORT OF THE BUREAU OF MINES 1909

**VOL. XVIII** **PART I**

## STATISTICAL REVIEW

**By Thos. W. Gibson, Deputy Minister of Mines**

The mines and mineral works of Ontario in 1908 again surpassed in aggregate value of production the record of any previous year. The output was valued in the returns to Bureau at $25,637,617, as against $25,019,373 in 1907, hitherto the highest figure reached. One of the most important products, silver, maintained a low price throughout the year, and the depressing influence of this fact was felt not only in the lessened value but also in the restricted amount of the yield. The metallic products, the principal of which were silver, pig iron, nickel and copper, furnished 65 per cent. of the total value, and the non-metallic substances 35 per cent. Of the latter the most important were Portland cement, bricks, natural gas, petroleum, stone, salt and lime, in the order named. For the first time the value of the natural gas produced was greater than that of petroleum, the former being nearly one million dollars, while the latter was but little over seven hundred thousand dollars. The production of the former is steadily increasing, and of the latter declining.

The following table presents a summary of the mineral production for the year, with columns giving the number of employees and the amount of wages paid in connection with the several products:—

**Table I.—Mineral Production of Ontario 1908**

| Product. | | Quantity. | Value. | Employees. | Wages. |
|---|---|---|---|---|---|
| Metallic: | | | $ | | $ |
| Gold | ounces | 3,465 | 60,337 | 358 | 80,197 |
| Silver | " | 19,444,400 | 9,136,830 | 2,414 | 2,159,055 |
| Cobalt | tons | 1,224 | 111,118 | | |
| Nickel | " | 10 175 | 1,866,059 | 1,722 | 1,306,665 |
| Copper | " | 7,561 | 1,071,140 | | |
| Iron ore | " | 216,177 | 574,839 | 366 | 222,234 |
| Pig iron | " | 271,656 | 4,390 839 | 1,807(*a*) | 1,001,893(*a*) |
| | | | 17,211,162 | 6,834 | 4,770,044 |
| Less value Ontario iron ore (170,215 tons) smelted into pig iron | | | 456,176 | | |
| Net metallic production | | | 16,754,986 | 6,834 | 4,770,044 |
| Non-metallic: | | | | | |
| Arsenic, refined | tons | 702 | 40,373 | (*b*) | (*b*) |
| " crude | " | 2,970 | ............ | | |
| Brick, common | No. | 222,361.000 | 1,575,875 | 3,084 | 845,606 |
| Tile, drain | " | 24,800,000 | 338,658 | | |
| Brick, pressed, etc | " | 56,166,554 | 485,819 | 529 | 254,712 |
| " paving | " | 3,894,820 | 61,554 | | |
| Building and crushed stone | | | 530,041 | 1,022 | 358,514 |
| Calcium carbide | tons | 2,361 | 147,150 | 64 | 40,944 |
| Cement, Portland | bbl | 2,022,877 | 2,417,769 | 1,642 | 645,953 |
| Corundum | tons | 106 | 11,437 | 170 | 19,250 |
| Feldspar | " | 7,875 | 20,300 | 35 | 15,631 |
| Graphite, refined | " | 10 | 1,600 | 16 | 2,850 |
| Gypsum | " | 10,389 | 20,778 | 51 | 15,168 |
| Iron pyrites | " | 20,970 | 69,980 | 132 | 95,740 |

(*a*) Includes steel making. (*b*) Included in Silver and Cobalt.

### Table I.—Continued

| Product. | Quantity. | Value. | Employees. | Wages. |
|---|---|---|---|---|
| Non-metallic : | | $ | | $ |
| Lime.....bush. | 2,442,331 | 448,595 | 387 | 149,704 |
| Mica.....tons | 368 | 73,586 | 108 | 40,466 |
| Natural gas..... | ..... | 988,616 | 152 | 106,786 |
| Peat fuel.....tons | 200 | 900 | 4 | 850 |
| Phosphate of lime..... " | 881 | 7,048 | 10 | 2,860 |
| Petroleum.....Imp. gals. | 18,479,547 | 703,773 (c) | 430 (d) | 247,829 (d) |
| Pottery..... | ..... | 50,310 | 43 | 15,702 |
| Quartz.....tons | 44,741 | 52,830 | 69 | 32,594 |
| Salt..... " | 79,112 | 488,330 | 195 | 93,700 |
| Sewer pipe..... | ..... | 344,260 | 202 | 101,840 |
| Talc.....tons | 1,016 | 3,048 | 10 | 1,524 |
| Non-metallic production..... | ..... | 8,882,631 | 8,355 | 3,088,223 |
| Add net metallic production..... | ..... | 16,754,986 | 6,834 | 4,770,044 |
| Total..... | ..... | 25,637,617 | 15,189 | 7,858,267 |
| Total for 1907..... | ..... | 25,019,373 | 13,613 | 7,747,195 |

(c) Value crude petroleum, exclusive of Dominion Government bounty. (d) Petroleum refining works only.

A comparison between the output of 1908 and that for 1907 shows the following changes in production:—

### Table II.—Comparative Value Mineral Production 1907 and 1908

| Product. | 1907. | 1908. | Change. (I) Increase. (D) Decrease. | |
|---|---|---|---|---|
| Metallic : | $ | $ | | $ |
| Gold..... | 66,399 | 60,337 | D | 6,062 |
| Silver..... | 6,157,871 | 9,136,830 | I | 2,978,959 |
| Cobalt..... | 92,751 | 111,118 | I | 18,367 |
| Nickel..... | 2,271,616 | 1,866,059 | D | 405,557 |
| Copper..... | 1,045,511 | 1,071,140 | I | 25,629 |
| Iron ore..... | 482,532 | 574,839 | I | 92,307 |
| Pig iron..... | 4,716,857 | 4,390,839 | D | 326,018 |
| Non-metallic : | | | | |
| Arsenic..... | 40,104 | 40,373 | I | 269 |
| Brick, common..... | 2,109,978 | 1,575,875 | D | 534,103 |
| " pressed..... | 648,683 | 485,819 | D | 162,864 |
| " paving..... | 73,270 | 61,554 | D | 11,716 |
| Building and crushed stone..... | 675,000 | 530,041 | D | 144,959 |
| Calcium carbide..... | 173,763 | 147,150 | D | 26,613 |
| Cement, Portland..... | 2,777,478 | 2,417,769 | D | 359,709 |
| " natural rock..... | 5,097 | ..... | D | 5,097 |
| Corundum..... | 242,668 | 11,437 | D | 231,171 |
| Feldspar..... | 30,375 | 20,300 | D | 10,075 |
| Graphite..... | 20,000 | 1,600 | D | 18,400 |
| Gypsum..... | 19,652 | 20,778 | I | 1,126 |
| Iron pyrites..... | 51,842 | 69,980 | I | 18,138 |
| Lime..... | 418,700 | 448,596 | I | 29,896 |
| Mica..... | 82,929 | 73,586 | D | 9,343 |
| Natural gas..... | 746,499 | 988,616 | I | 242,117 |
| Peat fuel..... | 1,040 | 900 | D | 140 |
| Phosphate of lime..... | ..... | 7,048 | I | 7,048 |
| Petroleum..... | 1,049,631 | 703,773 | D | 345,858 |
| Pottery..... | 54,585 | 50,310 | D | 4,275 |
| Quartz..... | 124,148 | 52,830 | D | 71,318 |
| Salt..... | 432,936 | 488,330 | I | 55,394 |
| Sewer pipe..... | 435,088 | 344,260 | D | 90,828 |
| Talc..... | 5,010 | 3,048 | D | 1,962 |
| Tile, drain..... | 250,122 | 338,658 | I | 88,536 |

The principal increases and decreases in production shown by the foregoing figures will be dealt with at greater length when treating of the individual items in a later stage of this Report.

### Basis of Statistical Values

The methods employed in valuing mineral products for statistical purposes by the mining departments of the Dominion Government and the several Provinces are diverse, and comparisons founded upon statistics drawn from official sources should take into account the plan upon which they are compiled. For example, one of the leading metallic products of Ontario, and indeed of Canada, is nickel. The Geological Survey of Canada[1] gives the production as 19,143,111 lbs., or 9,572 tons. In Table I. of this Report the quantity is given as 10,175 tons. Canadian nickel comes wholly from the mines of Ontario. As shown below, the silver-cobalt deposits yielded 612 tons of nickel. This quantity is not taken into account by the Geological Survey, so that the production of the Sudbury deposits as given by the Survey and the Bureau of Mines is practically the same, being 9,572 tons and 9,563 tons respectively. Yet the value assigned to the nickel output of 1908 by the Survey is $8,231,538, while the Bureau's valuation is only $1,866,059.

Why this great discrepancy? Simply because the basis of valuation in one case is entirely different from that in the other. The Survey values the nickel contents of the mattes produced by the Sudbury furnaces at the average price of refined nickel in New York, while the Bureau's figures represent the value of the nickel in the form of matte and at the point of production, as given by the producers. To reckon the charges for transportation to the United States or England, the cost of separating the nickel from the matte and probably also the profit arising from the whole series of processes to which the ore is subjected from mine to finished product, as part of the value of the nickel when it leaves Canada in the matte, certainly helps to swell the aggregate value of the mineral production, but the propriety of the method is not free from doubt.

On the other hand, in the matter of pig iron, the Survey credits Canada only with the product of Canadian ore, excluding all pig iron made from imported ores, while the Bureau includes the value of all the pig iron made at the blast furnaces of the Province regardless of the source of the ore, deducting from the aggregate the value of Ontario ore smelted into pig iron, so as to avoid reckoning the value of this item twice, once as iron ore and again as pig iron. It is evident that statistics compiled on plans so different bear little real relation to each other, and it could be wished that some common system might be devised and adopted by the various authorities engaged in collecting and publishing official statistics of the mining industry of the several Provinces and of the Dominion as a whole.

The net result so far as Ontario is concerned is to conceal her relative importance as a producer of minerals. Since the Geological Survey gives the figures for Canada only, and not for the individual Provinces, it is natural for any one wishing to ascertain the standing of a given Province to compare the production as given by the Provincial authority with the aggregate for the Dominion as given by the Geological Survey. A conclusion thus arrived at in the case of Ontario would almost certainly be a mistaken one, so far at any rate as regards most of the metalliferous products, the Survey valuing non-metallic products at the mine or point of shipment.

In order to enable the production of Ontario to be fairly compared with that of the rest of Canada as given by the Geological Survey, Table I. has been re-compiled

[1] Preliminary Report on the Mineral Production of Canada in 1908.

upon the system adopted by the latter, both as to quantities and prices. The result is seen below:—

**Table III.—Value Mineral Production 1908, "Geological Survey" Basis**

| Product. | Quantity. | Price. | Value. |
|---|---|---|---|
| | | | $ |
| Gold ........oz. | 3,465 | $17.41 per oz ........ | 60,337 |
| Silver ........ " | 19,444,400 | 52.864 cents per oz ........ | 10,543,410 |
| Cobalt ........tons | 1,224 | $90.78 per ton ........ | 111,118 |
| Nickel ........ " | 9,563 (a) | 43 cents per lb........ | 8,224,180 |
| Copper........ " | 7,561 | 13.208 cents per lb........ | 1,997,314 |
| Pig iron ........ " | 86,244 (b) | $16.16 per ton ........ | 1,393,703 |
| | | | 22,330,062 |
| Value non-metallic production per Table I ........ | | | 8,882,631 |
| Gross value production ........ | | | $31,212,693 |

(a) Contents Sudbury mattes only. (b) Proportion pig iron from Ontario ores.

The value of the total production of Canada for 1908, as given by the Geological Survey, being $87,323,849, it will be seen that on this basis Ontario produced about 36 per cent. of the whole, and this after allowing for cobalt the value of the crude only, not that of the finished product, cobalt oxide; such being the Survey's method of dealing with this particular item. It will be noted too that exports of iron ore are excluded, and that in pig iron, only the product of Ontario ore is taken into account.

If coal be excluded, this Province contributed more than one-half of the total production of Canadian minerals, metallic and non-metallic, in 1908. In the metals Ontario claims first place among the Provinces. The aggregate value of the metallic output of Canada last year, according to the Geological Survey, was $41,655,936, of which, as will be seen by the preceding table, $22,330,062 is to be credited to the mines of Ontario, or about 54 per cent. The value of the silver taken from the mines of Cobalt was almost three times that of the gold obtained from the placers of the Yukon.

In the following table is shown the mineral production of the Province for the last five years, the story being one of steady, and in the metallic list, of rapid and uninterrupted advance.

**Table IV.—Mineral Production 1904 to 1908**

| Product. | 1904 | 1905 | 1906 | 1907 | 1908 |
|---|---|---|---|---|---|
| Metallic: | $ | $ | $ | $ | $ |
| Gold........ | 40,000 | 99,885 | 66,193 | 66,399 | 60,337 |
| Silver........ | 111,887 | 1,372,877 | 3,689,286 | 6,157,871 | 9,136,830 |
| Platinum........ | 10,452 | } 28,116 | 5,652 | ........ | ........ |
| Palladium........ | 18,564 | | | | |
| Cobalt........ | 36,620 | 100,000 | 80,704 | 92,751 | 111,118 |
| Copper........ | 297,126 | 688,993 | 960,813 | 1,045,511 | 1,071,140 |
| Nickel........ | 1,516,747 | 3,354,934 | 3,839,419 | 2,271,616 | 1,866,059 |
| Iron ore........ | 108,068 | 227,909 | 301,032 | 482,532 | 574,839 |
| Pig iron........ | 1,811,664 | 3,909,527 | 4,554,247 | 4,716,857 | 4,390,839 |
| Steel........ | 1,188,349 | 3,321,884 | (a) | (a) | (a) |
| Lead ore........ | 11,000 | ........ | ........ | ........ | ........ |
| Pig lead........ | 2,500 | 9,000 | 93,500 | ........ | ........ |
| Zinc ore........ | 3,700 | ........ | 6,000 | ........ | ........ |
| | 5,156,677 | 13,113,125 | 13,596,846 | 14,833,537 | 17,211,162 |
| Less value Ontario iron ore smelted into pig iron, and pig iron converted into steel.. | 250,000 | 2,912,115 | (b) 243,766 | (b) 282,702 | (b) 456,176 |
| Net metallic production........ | 4,906,667 | 10,201,010 | 13,353,080 | 14,550,835 | 16,754,986 |

(a) Steel production not included. (b) Iron ore only.

**Table IV.—Continued**

| Product. | 1904 | 1905 | 1906 | 1907 | 1908 |
|---|---|---|---|---|---|
| Non-metallic: | $ | $ | $ | $ | $ |
| Actinolite | 102 | ........ | ........ | ........ | ........ |
| Arsenic | 903 | 2,693 | 15,858 | 40,104 | 40.373 |
| Brick, common | 1,430,000 | 1,937,500 | 2,157,000 | 2,109,978 | 1,575.875 |
| " paving | 55,450 | 54,000 | 45,000 | 73.270 | 61,554 |
| " pressed | 226,750 | 234,000 | 337,795 | 648,683 | 485,819 |
| Building and crushed stone | 700,000 | 700,000 | 660,000 | 675,000 | 530,041 |
| Carbide of calcium | 152,295 | 156,755 | 162,780 | 173,763 | 147,150 |
| Cement, natural rock | 65,250 | 10,402 | 6,000 | 5,097 | ........ |
| " Portland | 1,239,971 | 1,783,451 | 2,381,014 | 2,777,478 | 2,417,769 |
| Corundum | 150,645 | 152,464 | 262,448 | 242,608 | 11,437 |
| Feldspar | 21.966 | 29,968 | 43,849 | 30,375 | 20,300 |
| Graphite | 4,700 | 9,825 | 15,000 | 20,000 | 1,600 |
| Gypsum | 10,674 | 4,118 | 6,605 | 19,652 | 20,778 |
| Iron pyrites | 43,716 | 21,885 | 40,583 | 51,842 | 69,980 |
| Lime | 406,800 | 424,700 | 496,785 | 418,700 | 448,596 |
| Mica | 37,847 | 50,446 | 69,041 | 82,929 | 73,586 |
| Natural gas | 253,524 | 316,476 | 533,446 | 746,499 | 988,616 |
| Peat fuel | 2,400 | 1,200 | 900 | 1,040 | 900 |
| Petroleum (crude) | 904,437 | 898,545 | 761,546 | 1,049,631 | 703,773 |
| Phosphate of lime | ........ | ........ | ........ | ........ | 7,048 |
| Pottery | 100,000 | 60,000 | 65,000 | 54,585 | 50,310 |
| Quartz | ........ | ........ | 65,765 | 124,148 | 52,830 |
| Salt | 362,621 | 356,783 | 367,738 | 432,936 | 488.330 |
| Sewer pipe | 283,000 | 225,835 | 279.620 | 435,088 | 344,260 |
| Sodalite | ........ | ........ | 6,000 | ........ | ........ |
| Talc | 2,919 | 2,240 | 3,030 | 5,010 | 3,048 |
| Tile, drain | 210,000 | 220,000 | 252,500 | 250,122 | 338,658 |
| Total non-metallic production | 6,665,970 | 7,653,286 | 9,035,303 | 10,468,538 | 8,882,631 |
| Add metallic production | 4,906,677 | 10,201,010 | 13,353,080 | 14,550,835 | 16,754.986 |
| Total production | 11,572,647 | 17,854.296 | 22,388,383 | 25,019,373 | 25,637.617 |

### Gold

The number of companies producing gold last year was seven. These were Imperial Gold Mines (Laurentian mine), Lepage Gold Mining Company, (Grace mine, Michipicoten), Grace Mining Company (Eagle lake), Cleveland Gold Mining Company, Empire Mining and Milling Company, Crystal Gold Mining and Milling Company, and the Golden Reed Mining Company. Most of these carried on operations intermittently and on a small scale, the principal producers being the Imperial, Lepage and Cleveland companies. The total production of bullion was 3,465 ounces valued at $60,337.

Interest in the gold districts of Sturgeon Lake and Lower Seine river was stimulated by promising finds in both places, the discoveries in the latter being at Glenorchy, about 40 miles east of Fort Frances, near many gold properties which were actively worked ten or twelve years ago, but have since been abandoned. All the eastern Ontario mines were idle, and of the Larder Lake companies none are yet steadily milling ore.

### Silver

Though Cobalt is not the only, it is the chief, source of silver in Ontario at the present time, the mines of that region producing an overwhelming proportion of the total yield. Other contributions were from the Port Arthur district, where one or two silver mines were operated during the year, and from the bullion produced at some of the gold mines. The total yield was 19.444.400 ounces, of which the mines of Cobalt produced 19,437,875 ounces, being an increase over the output in 1907 of 94 per cent Ontario is now third in rank among the silver producing communities of the world, Mexico heading the list, and the United States coming second. The world's production in 1908 is placed at 183,800,000 ounces, so that Ontario's share of the output was about 11 per cent.

The course of prices for silver during the year was unsatisfactory. In New York the average in January per fine ounce was 55.678 cents; it rose in February to 56 cents, then fell steadily until August when the average was 51.683 cents. September saw a slight rally to 51.720 cents, but a further decline set in, and the year closed with an average for December of 48.769 cents, the average for the twelve months being 52.864 cents per ounce. The effect of the low level of prices on the production of the Cobalt mines, though comparatively unimportant, tended towards a restriction of the output; at any rate, there is little doubt that had the market been such as to tempt the mines to make a larger production, this could easily have been achieved. Notwithstanding the fall in price, the margin of profit is still large, some of the Cobalt mines who have published their cost sheets alleging their ability to produce silver at 7½ to 20.7 cents per ounce.

#### The Producing Mines

There were thirty producing mines at Cobalt in 1908, the following list giving their names in the order of production:—Nipissing, O'Brien, LaRose, Crown Reserve, Kerr Lake, Coniagas, Temiscaming and Hudson Bay, Temiscamingue, Buffalo, Drummond, Trethewey, McKinley-Darragh-Savage, Cobalt Silver Queen, City of Cobalt, Standard Cobalt, Right-of-Way, Silver Leaf, King Edward, Cobalt Townsite, Nova Scotia. Other shippers were Foster Cobalt, Silver Cliff, Chambers-Ferland, Cobalt Lake, Peterson Lake, Nancy Helen, Provincial, Keeley, Colonial, Casey Cobalt. The most notable addition to the productive mines during the year was the Crown Reserve. This mine was opened up on that part of the bed of Kerr lake sold by tender by the Government of the Province in January, 1907, the price paid being $178,500 together with a royalty of 10 per cent. on the value of the output at the pit's mouth. A large vein, rich even for Cobalt, was struck during development work, and the Crown Reserve was a heavy shipper of high-grade ore during the year.

The quantity of ore and concentrates shipped out of the Cobalt camp in 1908 was 25,624 tons. Of this 24,487 tons was ore and 1,137 tons concentrates. The ore averaged 736 ounces per ton, and the concentrates 1,244 ounces. Only the poorer classes of ore, such as will not pay to ship, are subjected to concentration. This is evident from the fact that in order to obtain 1,185 tons of concentrates—the total production—50,997 tons of ore and rock were put through the concentrating plants, being in the proportion of 43 tons of ore to one ton of concentrates. The silver recovered was about 28 ounces per ton of material treated, but the loss in the tailings would raise the average contents of the rock a little above this point.

As in former years, the bulk of the ore, so far as tonnage is concerned, was exported to the United States, where there is a demand, particularly from the smelters of Denver, Colorado, for the silicious low-grade ores of Cobalt for mixture with the sulphide concentrates resulting from the mill treatment of the gold and silver ores of Cripple Creek and Creede. Some shipments to the United States were of high grade, but the gross value of the ores treated in Canadian smelters was almost three times the value of those exported. The value per ton of the shipments to the United States was about $120, while that of the ores refined at home was about $825. The distribution of the output of the Cobalt mines for 1908 is given by the T. & N. O. Railway Commission as follows:—

| | Tons. | Per cent. |
|---|---|---|
| Canada | 7,401.14 | 29.18 |
| Great Britain | 222.08 | .88 |
| Germany | 229.46 | 1.18 |
| United States | 17,439.42 | 68.76 |

The output of silver from the beginning of mining operations in the Cobalt camp is shown in the following table:—

### Table V.—Silver Production, Cobalt Mines, 1904 to 1908

| Year. | Producing Mines. | Shipments. | | Silver Contents. | | Average Silver Contents per Ton. | | Value of Shipments. | | Total Value. |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Ore. Tons | Concentrates. Tons. | Ore. oz. | Concentrates. oz. | Ore. oz. | Concentrates oz. | Ore. $ | Concentrates. $ | $ |
| 1904.... | 4 | 158 | ....... | 206,875 | ........... | 1,309 | ....... | 111,887 | ......... | 111,887 |
| 1905.... | 16 | 2,144 | ....... | 2,451,356 | ........... | 1,143 | ....... | 1,360,503 | ......... | 1,360,503 |
| 1906.... | 17 | 5,335 | ....... | 5,401,766 | ........... | 1,013 | ....... | 3,667,551 | ......... | 3,667,551 |
| 1907.... | 28 | 14,788 | ....... | 10,023,311 | ........... | 677 | ....... | 6,155,391 | ......... | 6,155,391 |
| 1908.... | 30 | 24,487 | 1,137 | 18,022,480 | 1,415,395 | 736 | 1,244 | 8,468,293 | 665,085 | 9,133,378 |
| Total. | ........ | 46,912 | 1,137 | 36,105,788 | 1,415,395 | 769 | 1,244 | 19,763,625 | 665,085 | 20,428,710 |

#### Total Silver Production of Ontario

An attempt has been made to ascertain the entire yield of silver in Ontario up to the present time. The statistics of production while the Silver Islet mine, and later the mines on the mainland in the Port Arthur region, were being worked, were not officially collected, and it is difficult now to reconstruct them with exactness, as the figures of the output of individual properties given or referred to in the reports of the Geological Survey of Canada and the Bureau of Mines are incomplete, and in some instances contradictory.

The greater part of the silver so far obtained in the Lake Superior region has come from the Silver Islet mine. This deposit was discovered in 1868, and operations were begun in September, 1870, finally ceasing in 1884. The output is valued by different authorities, at sums varying from $3,000,000 up to $4,500,000. Mr. W. A. Preston, M.P.P., estimates it at $3,000,000. Mr. T. A. Keefer, of Port Arthur, puts the production at "upwards of $3,000,000."[2] Mr. A. J. Cattanach, of Toronto, who had been "connected with the mine almost from the beginning," gives it as $3,089,157.[3] Mr. E. D. Ingall tabulates the production year by year, showing it to have had a total value of $3,047,532.04, but adopts the statement of Mr. Richard Trethewey, superintendent of the mine when it closed, that the total value of silver produced from the commencement to the close of operations, was $3,250,000.[4] Mr. A. Blue, late Director of the Bureau of Mines, says the mine "yielded in all from first to last $3,500,000."[5] Mr. F. S. Wiley, Port Arthur, agrees with this. Mr. S. J. Dawson, of Port Arthur, somewhat loosely estimates the exports from the mine at $3,500,000 to $4,500,000.[6]

Mr. Ingall's data appear to be collected from authentic sources. He gives the number of ounces of silver produced at Silver Islet yearly, from 1872 to 1878 inclusive, amounting to 1,878,443 ounces. From 1868 to 1871 the value of the production is placed at $763,400.59, and in 1882 at $30,000, but for neither period are the figures of quantity given. At $1.32 per ounce, the New York price of silver from 1868 to 1871, the yield for these years would be 578,333 ounces, and at $1.13, the price in 1882, it would for the latter year be 26,548 ounces. These items aggregate 2,483,324 ounces worth $3,047,532.04. This comes short of Mr. Trethewey's total by $202,467.96, which, according to Mr. Ingall, probably represents the results obtained from the poorer mill rock after the rich ores were worked out. The silver equivalent of this amount at $1.13 per ounce is 179,175 ounces, making up a grand total of 2,662,509 ounces, valued at $3,250,000.

[2] Rep. Com. Min. Res. Ont., 1890, p. 63. [3] *Ibid*, p. 195. [4] Mines and Mining on Lake Superior, Rep. Geo. Sur Can., 1887-88, p. 37 H. [5] 6th Rep. Bur. Min., p. 158. [6] Rep. Com. Min. Res. Ont., p. 197.

From several gentlemen, interested in mining, whose experience and recollection cover the productive periods of the Lake Superior silver region, and who had good opportunities of learning the facts, figures of production from the mines on the mainland have been obtained, differing as to individual properties, but agreeing closely in the total. Statement No. 1 is furnished by Mr. W. A. Preston, M.P.P.; statement No. 2 by Mr. F. S. Wiley.

**Statement No. 1**

| | |
|---|---|
| Beaver mine | $550,000 |
| Silver Mountain, East and West End | 500,000 |
| Badger and Porcupine | 300,000 |
| Rabbit Mountain | 50,000 |
| Thunder Bay mine | 20,000 |
| Shuniah mine | 50,000 |
| 3 A and Beek mine | 10,000 |
| Jarvis Mining Company | 40,000 |
| Total | $1,520,000 |

**Statement No. 2**

| | |
|---|---|
| Beaver mine | $700,000 |
| Silver Mountain, East End | 30,000 |
| do West End | 300,000 |
| Badger and Porcupine | 500,000 |
| Other properties | 50,000 |
| Total | $1,580,000 |

The price of silver from 1882 to 1890, when the bulk of the production from these mines was made, fell from $1.136 per ounce in the former year to $0.935 in 1889 and to $1.046 in 1890. The average during the period would be about $1.035 per ounce. Applying this price to the smaller of the above estimates, and we have 1,468,599 ounces as the quantity obtained up to the closing of the mines in 1893. One or two of the Lake Superior mines, notably Silver Mountain West End, have been worked in a more or less desultory way since that time, beginning in 1898, the output from 1898 to 1903, according to returns made to the Bureau of Mines, being 617,433 ounces valued at $365,681.

We can now sum up, as follows:

| | Oz. silver. | Value. |
|---|---|---|
| Silver Islet mine | 2,662,509 | $3,250,000 |
| Mainland group, to 1893 | 1,468,599 | 1,520,000 |
| do 1894 to 1903 inc. | 617,433 | 365,681 |
| Production previous to opening of Cobalt mines | 4,748,541 | $ 5,135,681 |
| do subsequent do do | 37,586,970 | 20,468,751 |
| Total production to 31st December, 1908 | 42,335,511 | $25,604,432 |

**Refining Plants and Concentrators**

There were three reduction plants in Ontario treating ore from the mines of Cobalt last year, namely, those of the Canadian Copper Company at Copper Cliff, the Deloro Mining and Reduction Company at Deloro, and the Coniagas Reduction Company at Thorold. Through these works there were passed an aggregate of 6,958 tons of ore containing 11,658,008 ounces of silver, of which 8,972,958 fine ounces were recovered, the remainder, 2,685,050 ounces being contained in the speiss product reserved or exported for further treatment. This does not include the operations of the Nipissing Reduction Company or the Muggley Concentrators, Limited, at Cobalt, which carried on a concentrating business only, shipping the product to smelters for refining. The number of workmen employed at these various plants was 247, and the wages paid $172,675.

The following companies have installed concentrating mills which were in operation during the year:—Buffalo Mines Company, Coniagas Mines, Standard Cobalt Mines, King Edward Cobalt Mines; and in addition to these there were custom plants owned and operated by the Northern Customs Concentrators, (formerly Muggley Concentrators),

and the Nipissing Reduction Company. There were also under construction concentrating mills at the Colonial, McKinley-Darragh-Savage, Nova Scotia and O'Brien mines. Undoubtedly concentration of the low-grade ores, carrying say up to 100 ounces silver per ton, will henceforward form an importaut feature in the practice of the Cobalt camp.

#### Ore Purchasers

Ore purchasers were somewhat more numerous in 1908 than in 1907. The American Smelting and Refining Company, New York, bought numerous consignments both for its Perth Amboy, N.J., and Denver, Col., works; the Pennsylvania Smelting Company of Pittsburg, Penn., whose plant is at Carnegie, Penn., also bought considerable ore, while the Balbach Smelting and Refining Company of Newark, N.J., and the United States Metal and Refining Company of Chrome, N.J., were occasionally in the market for high grade material. The Canadian Copper Company, Copper Cliff, Ontario, bought a large part of the high grade output of the camp. The Deloro Mining and Reduction Company, of Deloro, Ontario, while running mainly on the more valuable ores of the O'Brien mine, also bought and treated high class ores from other properties. The Coniagas Reduction Company at Thorold, Ontario, confined itself to the ores and concentrates of the Coniagas mine. The Consolidated Mining and Smelting Company of Trail, B.C., took a few carloads. Beer, Sondheimer Company of Hamburg, Germany, purchased several lots of rich ore, and the Anglo-French Nickel Company of Swansea, Wales, a few consignments of silver-free cobalt ore.

The purchasing schedules of these several concerns are subject to frequent changes, induced by the rise and fall of the price of silver and other causes, but on the whole it can be said that the mines of Cobalt experienced a fair measure of competition for their output throughout the year.

#### Arsenic, Nickel, Cobalt

The elements other than silver in the ores of the Cobalt camp are at present of comparative little value, at any rate to the miners of the ore. Arsenic is no longer paid for by ore-buyers, and nickel is regarded as an impurity warranting the imposition of a penalty if in excess of the cobalt contents.

Cobalt itself is also much less valuable since the mines of this district were opened. The world's demand for cobalt oxide is in the neighbourhood of 275 or 300 (short) tons per annum, while the product of the Cobalt mines, if all converted into oxide, would amount to upwards of 1,500 tons per annum. Where a sudden increase in the supply of a useful commodity is accompanied by a fall in price, there is a tendency to employ the commodity more freely than before and also to find new uses for it. So far, however, there has been little increase in the demand for cobalt oxide, and no fresh methods of utilizing the element or its compounds have given any considerable impetus to its employment. The inevitable result has been a severe fall in the price of cobalt oxide, notwithstanding the efforts of those engaged in and hitherto controlling its manufacture to maintain the old level. In 1907 the ruling rate was $2.50 per pound, but successive reductions have brought the price down to about a dollar per pound, with prospect of a still lower level. In such circumstances it was but natural that the value of cobalt in the ore should also fall, and as a matter of fact for the greater part of the cobalt contained in the ore shipments of 1908, the mine-owners received nothing at all. Even for silver-free cobalt ore the price has been reduced, and now ranges from 25 cents to 45 cents per pound, according to the proportion of the cobalt contents upwards from eight per cent.

#### Labour Employed

The number of men employed in the silver mines of Cobalt, including also those engaged in the works for the reduction of the ores at Copper Cliff, Deloro and Thorold was 2,414, and the amount paid out in wages $2,159,055. Of these 1,089 were under-

ground workers and 1,325 above ground. The development of the Cobalt mines in the employment of labour is indicated by the following figures:

| Year. | Number of men employed. | | Wages paid. |
|---|---|---|---|
| | Above ground. | Under ground | |
| | | | $ |
| 1904 | 29 | 28 | 12,300 |
| 1905 | 289 | 186 | 191,582 |
| 1906 | 471 | 586 | 581,253 |
| 1907 | 1,201 | 826 | 1 525,019 |
| 1908 | 1,325 | 1,089 | 2,159,055 |

There were no labour strikes or troubles in Cobalt during 1908.

Location stakes iu the forest.

Gowganda, February, 1909.

The following table shows the entire production of silver, cobalt, nickel and arsenic from the mines of the Cobalt district beginning with their opening in 1904.

### Table VI.—Total Production Cobalt Mines 1904 to 1908

| Year. | Ore shipments. | Nickel. | | Cobalt. | | Arsenic. | | Silver. | | Total Value. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Tons. | Tons. | Value. | Tons. | Value. | Tons. | Value. | Ounces. | Value. | |
| | | | $ | | $ | | $ | | $ | $ |
| 1904 ........... | 158 | 14 | 3,467 | 16 | 19,960 | 72 | 903 | 206,875 | 111,887 | 136,217 |
| 1905............ | 2,144 | 75 | 10,000 | 118 | 100,000 | 549 | 2,693 | 2,451,356 | 1,360,503 | 1,473,196 |
| 1906............ | 5,335 | 160 | .......... | 321 | 80,704 | 1,440 | 15,858 | 5,401,766 | 3,667,551 | 3,764,113 |
| 1907............ | 14,788 | 370 | 1,174 | 739 | 104,426 | 2,958 | 40,104 | 10,023,311 | 6,155,391 | 6.301,095 |
| 1908............ | 25,624 | 612 | .......... | 1,224 | 111,118 | 3,672 | 40,373 | 19,437,875 | 9,133,378 | 9,284,869 |
| Total ........ | 48,049 | 1,231 | 14,641 | 2,418 | 416,208 | 8,691 | 99.931 | 37,521,183 | 20,428,710 | 20,959,490 |

#### Tonnage of Ore Produced

The following table shows the number of tons of ore shipped by the various producing mines of Cobalt during the year 1908, and from the beginning of the camp to the end of that year. The figures are taken from the report of Mr. Arthur A. Cole, the Temiskaming and Northern Railway Commission's mining engineer for 1908. There is a slight discrepancy between Mr. Cole's figures and those returned to the Bureau by the mine-owners, but the difference is not important.

### Table VII.—Tonnage of Ore Produced by Shipping Mines of Cobalt

| — | Mine. | Shipments in 1908. | Total shipments from 1904 to 1908. |
|---|---|---|---|
| | | Tons. | Tons. |
| 1 | Bailey | 88.00 | 118.00 |
| 2 | Buffalo | 536.90 | 2,972.04 |
| 3 | Casey Cobalt | 10.00 | 10.00 |
| 4 | Chambers-Ferland | 223.89 | 223.89 |
| 5 | City of Cobalt | 761.04 | 811.65 |
| 6 | Cobalt Central | 187.99 | 265.32 |
| 7 | Cobalt Lake | 225.97 | 225.97 |
| 8 | Cobalt Townsite | 177.71 | 320.93 |
| 9 | Colonial | ................ | 55.38 |
| 10 | Coniagas | 610.25 | 3,510.24 |
| 11 | Crown Reserve | 657.35 | 657.35 |
| 12 | Drummond | 1,161.38 | 1,572.86 |
| 13 | Foster | 191.20 | 704.18 |
| 14 | Green Meehan | ................ | 135.42 |
| 15 | Imperial Cobalt | ................ | 14.61 |
| 16 | Kerr Lake | 660.24 | 1,193.30 |
| 17 | King Edward (Watts) | 338.19 | 388.31 |
| 18 | La Rose | 4,843.17 | 9,181.14 |
| 19 | Lawson | ................ | 75.73 |
| 20 | McKinley-Darragh | 1,808.39 | 3,098.35 |
| 21 | Nancy Helen | 201.32 | 231.42 |
| 22 | Nipissing | 3,571.96 | 8,778.32 |
| 23 | Nova Scotia | 237.95 | 554.11 |
| 24 | O'Brien | 3,459.51 | 5,091.62 |
| 25 | Peterson Lake (Little Nip) | 40.67 | 40.67 |
| 26 | Princess | ................ | 3.93 |
| 27 | Red Rock | ................ | 45.71 |
| 28 | Right of Way | 750.04 | 925.66 |
| 29 | Silver Bar | .58 | .58 |
| 30 | Silver Cliff | 160.44 | 160.44 |
| 31 | Silver Leaf | 197.03 | 252.39 |
| 32 | Silver Queen | 885.70 | 1,539.94 |
| 33 | Temiskaming | 795.20 | 999.52 |
| 34 | Temiskaming Cobalt | ................ | 88.45 |
| 35 | Temiskaming & Hudson Bay | 1,094.23 | 1,243.76 |
| 36 | Trethewey | 1,408.69 | 2,680.33 |
| 37 | University | ................ | 231.51 |
| 38 | Victoria | .47 | .47 |
| 39 | Violet | ................ | 36.00 |
| 40 | White Silver Mining Co | ................ | 28.45 |
| | Totals | 25,362.10 | 48,544.59 |

### Dividend-Paying Mines

Cobalt has given rise to a vast number of mushroom mining companies, so-called, whose operations were for the most part carried on in the advertising columns of city newspapers rather than among the rocks of the mining field itself; yet the amount paid out as dividends or profits to the shareholders of the producing companies has not only been very large in itself, but as compared with the value of the output has represented an unusual degree of profit. The table given on page 17 shows that fifteen companies have paid out as dividends $8,313,461.54, and the list does not include the O'Brien and Drummond mines, the former of which is a partnership concern, and the latter a close corporation. Reckoning these two among the dividend payers, it will be found that the total returns or profits divided have been very little if at all short of $10,000,000. The aggregate value of the production of the Cobalt camp from the beginning has been $20,962,942. Of this, as the table shows, almost fifty per cent. has been paid out as dividends

### New Silver Fields

The search for other Cobalts has led to the discovery of silver in South Lorrain and in several districts in the valley of the Montreal river and its branches. The broad geological features of the Cobalt area are repeated in these various regions, though there are somewhat marked differences in the relationships of the silver-bearing veins to the rock formations in the new fields as compared with the original one. In South Lorrain several promising properties are under development, and in the Elk Lake, Miller Lake and Gowganda districts the discoveries have been such as to warrant the hope that the deposits will prove remunerative.

In no case, however, has development proceeded sufficiently far to enable a positive statement to be made. In Gowganda the finds of native silver on the surface of the veins have been of remarkable quality, but on the whole the silver occurrences seem to be more irregular and of smaller proportions than those which have given Cobalt its pre-eminence among the silver camps of the world

It is to be remembered, however, that the Cobalt deposits, though a natural, hardly constitute a fair standard of comparison. The fact is, that had Cobalt remained undiscovered, the new finds at Elk lake, Miller lake and Gowganda would have been regarded as phenomenal. The minerals found are those of Cobalt—silver, smaltite and niccolite. The discoveries in the last named region were made in the summer of 1908, and, as was to be expected, led to a widespread staking of claims, many of them taken up during the winter when snow effectually hid the surface from view. "Discoveries" made under such circumstances are for the most part of doubtful worth, yet so hopeful are those interested in the new fields that the winter months saw a very large quantity of supplies and machinery taken in over the snow roads in the face of much hardship and difficulty; and the coming season of 1909 will no doubt see the possibilities of these latest camps pretty thoroughly investigated.

Town sites have been laid out by the Government at Smyth (Elk Lake P. O.) and Gowganda, and the lots sold for building purposes. At Elk Lake a thriving town has sprung into existence, which bids fair to become a place of considerable importance. A similar process is going on at Gowganda, where there are already a post office, several stores, hotels, banks, a saw-mill and the other necessary rudiments of a frontier community.

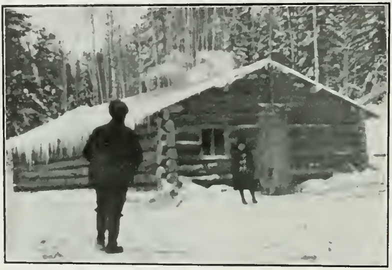
### Means of Communication

Means of communication, which are all important to the development of a mining camp or other settlement, are found in winter roads from Charlton and Earlton stations on the Temiskaming and Northern Ontario railway to Elk Lake, and from Elk Lake to Gowganda. There is also a winter route from Sellwood on the Canadian Northern railway north of Sudbury, via Burwash and Welcome lakes to Gowganda. These

## Table VIII.—Statement of Dividends Paid by Silver-Cobalt Mining Companies

| Name of Company. | Date of Incorporation. | Amount of Capital Stock authorized. | Amount of Capital Stock issued. | Par value of share. | Total Dividend and Bonuses declared up to Dec. 31st, 1907. | Total Dividend and Bonuses declared in 1908. | When last Dividend or Bonus declared. | Rate of last Dividend | Rate of last Bonus. |
|---|---|---|---|---|---|---|---|---|---|
| | | $ | $ | $ | $ | $ | | per cent. | per cent. |
| Foster Cobalt Mining Company, Limited | February 14, 1906 | 1,000,000 | 915,588 | 1.00 | 45,799 | ........ | January, 1907 | 5 | ........ |
| McKinley-Darragh-Savage Mines of Cobalt, Limited | April 17, 1906 | 2,500,000 | 2,246,937 | 1.00 | 44,146.96 | 314,697.06 | December 3, 1908 | 5 | ........ |
| La Rose Mines, Limited | February 21, 1907 | 6,000,000 | 6,000,000 | 1.00 | ........ | 420,000 | December, 1908 | 3 | 1 |
| Temiskaming Mining Company, Limited | November 16, 1906 | 2,500,000 | 2,500,000 | 1.00 | ........ | 359,156.25 | December, 1908 | 6 | ........ |
| Cobalt Central Mines Company, Limited | December 13, 1906 | 5,000,000 | 5,000,000 | 1.00 | ........ | 95,230 | December 17, '08 | 2 | ........ |
| The Buffalo Mines, Limited | April 27, 1906 | 1,000,000 | 1,000,000 | 1.00 | 162,000 | 135,000 | December 2, 1908 | 5 regular<br>1 extra | ........ |
| Cobalt Silver Queen, Limited | April 8, 1906 | 1,500,000 | 1,500,000 | 1.00 | 120,000 | 195,000 | December 1, 1908 | 3 | 2 |
| Tretheweу Silver Cobalt Mines, Limited | May 30, 1906 | 1,000,000 | 945,450 | 1.00 | 75,636 | 141,817.50 | November 13, '08 | 10 | ........ |
| The Coniagas Mines, Limited | November 24, 1906 | 4,000,000 | 4,000,000 | 5.00 | 360,000 | 440,000 | January 14, 1909 | 3 | 1 |
| The Nipissing Mining Company, Limited | December 16, 1904 | 250,000 | 250,000 | 1.00 | 1,710,000 | 860,000 | December 20, '08 | ........ | ........ |
| The Temiscaming and Hudson Bay Mining Company, Limited | July 29, 1903 | 25,000 | 7,761 | 1.00 | 735,700 | 271,200 | December 31, '08 | 300 | ........ |
| Right of Way Mining Company, Limited | July 13, 1906 | 500,000 | 499,518 | 1.00 | 69,889.75 | 69,932.52 | September 15, '08 | 7 | ........ |
| Crown Reserve Mining Company, Limited | January 16, 1907 | 2,000,000 | 1,999,957 | 1.00 | ........ | 353,762.80 | November 30, '08 | 24 | 1 for ½ yr |
| Kerr Lake Mining Company, Limited | August 15, 1905 | 40,000 | 40,000 | 1.00 | 810,000 | 450,000 | December 15, '08 | 225 | 75 |
| City of Cobalt Mining Company, Limited | October 5, 1906 | 500,000 | 500,000 | 1.00 | ........ | 44,493.70 | October 15, 1908 | 3 | 2 |
| Totals | ........ | 27,815,000 | 27,405,211 | ........ | 4,163,171.71 | 4,150,289.83 | ........ | ........ | ........ |

winter roads utilize the ice of the numerous lakes as part of the route, and consequently become unfit for use so soon as the ice and snow begin to melt in the spring. The waterways are then brought into requisition, and the Montreal river forms an admirable water route from Latchford on the T. & N. O. railway into the new silver fields. Steamers of considerable size ply on its waters, and the journey as far as Elk Lake can be made in summer time with little discomfort. Tramways are provided to facilitate the transport of freight over the portages.



Stopping-place 10 miles east of Gowganda, early in 1909.

Insley's stopping place, road to Gowganda. Winter 1908-09.

The trial from Charlton to Elk Lake is little used in the summer months, but an appropriation of $50,000 was made by the Legislature at the session of 1909 to provide an all-year road between the former point and Gowganda.

If the new camp proves a permanent one, it will require railway facilities, and the most natural means of supplying these would be by an extension of the T. & N. O. railway, probably from Charlton. Meantime, the Dominion Government proposes to erect a dam at Latchford for the purpose of drowning out the rapids at the head of Bay lake, and of improving the navigation of the Montreal river generally.

### Mining in a Forest Reserve

It is probably well to call attention here to the fact that the silver regions of the Montreal river are, with the exception of that part of the Elk Lake field which lies east of the river, wholly within the boundaries of the Temagami Forest Reserve, which fact introduces several features of the mining law peculiar to such a situation.

The territory having been set apart for the preservation and protection of the timber, the public interest requires that regard should be had to the timber as well as the minerals. To enable the Department to exercise some control over those who enter the Reserve for the purpose of searching for minerals, and to assist in meeting the expenses of a staff of fire-rangers necessary to prevent and extinguish fires, prospectors are required to procure a permit authorizing them to go into the Reserve, for which a fee of ten dollars is charged. This is valid for twelve months, and can be obtained only at the Department.

A prospector must also be the holder of a miner's license, which under the mining law of Ontario is the foundation for acquiring any of the mining lands of the Crown.

Having staked out and recorded a claim, it is necessary for the holder to apply at once to the Department for authority to work it. Outside of a Forest Reserve, the obligation to develop accrues immediately upon recording a claim, but within a Reserve a claim cannot legally be worked without the express authority of the Department. The reason for this is to give the Department an opportunity of protecting the forest by refusing to allow mining operations, involving as they necessarily do, the use of fire, in a district heavily covered say with red or white pine. If permission to work is given, the claim becomes subject to the ordinary requirements of the Mining Act respecting development work; if refused, work is not obligatory, and the claim is not liable to forfeiture for its non-performance. In any event, the time elapsing between the date of the claim-holder asking for permission to perform the work and the date of granting the same, does not run against the claim.

When the requirements of the Mining Act as to work have been fulfilled, the claim holder is entitled to obtain from the Department a lease, not a patent.

The charge for a lease is one dollar per acre for the first year, and twenty-five cents per acre per annum for the next nine years, the term of the lease being ten years. Leases are renewable for ten-year periods.

As all timber belongs to the Crown and is under special protection, none can be cut without the authority of the Department, all such cutting to be done under the supervision of the superintendent of the Reserve.

Observance of these regulations will spare prospectors and others interested or proposing to become interested in mining lands within a Forest Reserve, unnecessary trouble.

In Part II. of this Report Mr. A. G. Burrows gives the results of his examination of the South Lorrain and Gowganda silver areas, and exhibits the geology of the respective regions on coloured maps, one entitled Map of Part of Lorrain Township, District of Nipissing, Ontario, and the other Map of the Gowganda, Miller and Elk Lake areas, (Montreal River, Temagami Forest Reserve) District of Nipissing. Both are on a scale of one mile to the inch.

### Nickel

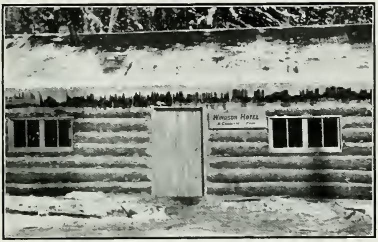
The mattes produced from the nickel-copper ores of the Sudbury region in 1908 contained 9.563 tons of nickel, while in the ores raised in the cobalt-silver mines, it is estimated there were 612 tons of nickel. The total quantity of nickel raised in the Province last year was therefore 10.175 tons, though a money value is given only to the Sudbury product, that from Cobalt being a negligible quantity in this respect, and for a large part probably never entering into consumption in the arts. The aggregate yield of nickel was 797 tons less, and the output of the Sudbury deposits 1,039 tons, less

Indian prospectors, winter.

Burwash, on Seliwood-Gowganda winter road.

than in 1907. The smaller production was due to the slackening of operations in the Sudbury field, the general depression in business leading to a falling-off in the demand. The value placed upon the nickel contents of the Sudbury mattes by the producers was $1,866,059.

The Canadian Copper Company carries on mining and smelting on an extensive scale, and makes the larger part of the matte product. Last year it extracted from the Creighton mine 222,497 tons of ore, and from the Crean Hill 118,066 tons. The




Windsor Hotel, Gowganda, February, 1909

Hotel, Gowganda, February, 1909.

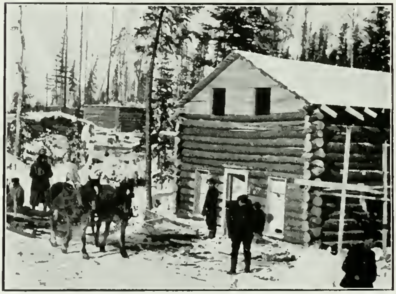
deposits at Copper Cliff, Stobie and other mines were not drawn upon. This company has a modern and very efficient plant, its smelters being situated at Copper Cliff.

### Monel Metal

The Canadian Copper Company has placed on the market a new combination of nickel and copper called "Monel metal," composed approximately of 68 per cent. nickel 30.5 per cent. copper and 1.5 per cent. iron. In smelting and refining the matte from

which "Monel metal" is made, the nickel and copper are not extracted or refined, and therefore appear in the finished product in the same relative proportions. As the treatment consists merely in eliminating the impurities, except a small percentage of reduced iron, the cost of production is much less than that of pure nickel, which is difficult and expensive of isolation. It is claimed for "Monel metal" that it is tough, strong, as little corrosive as pure nickel, equal to the latter in appearance, taking a

Saw-mill, Gowganda, February, 1909.



Main street, Gowganda, February, 1909.

high and attractive polish, and that its cost is such as to permit favourable competition with bronzes, German silver, etc. "Monel metal" can be cast for propeller wheels, rudders, valves, plumbing fixtures, jig plates, automobile parts and such other objects as are subjected to severe strain and shock, or where non-corrodibility is desirable; in hot rolled sheets it can be made into ship plates, sheathing, roofing, gutters, mine screens, etc.; in cold rolled sheets, into cooking utensils, milk cans, hospital equipment, watch cases, etc., and in bars, rods and wire, into shafts, piston rods, bolts and nuts, resistance wire, screws, rivets and articles of like kind. Its tensile strength is great and its elastic limit high. The melting point is given as 1,360 degrees centigrade, and its weight per cubic inch (rolled) .323 lbs.

The Mond Nickel Company's mines are situated in Denison and Garson townships, and its works at Victoria Mines, in the former. Like the Canadian Copper Company, it produces Bessemer matte of say 80 per cent. metallic contents, which is exported to Clydach, Wales, for refining by the Mond nickel carbonyl process. In 1908 the Mond Company raised 39,189 tons of ore from Victoria No. 1 mine; and 29,799 tons from the Garson mine.

The Dominion Nickel Copper Company, formed to exploit some large nickel ore deposits in the northern range, has not yet begun operations in the field.

The following table exhibits the course of the nickel-copper mining and smelting industry of Ontario for the past five years:

**Table IX.—Nickel-Copper Mining 1904 to 1908**

| Schedule. | | 1904 | 1905 | 1906 | 1907 | 1908 |
|---|---|---|---|---|---|---|
| Ore raised | tons | 203,388 | 284,090 | 343,814 | 351,916 | 409,551 |
| Ore smelted | " | 102,844 | 257,745 | 340,059 | 359;076 | 360,180 |
| Ordinary matte produced | " | 19,123 | ........ | ........ | ........ | ........ |
| High grade matte produced | " | 6,926 | (a) 17,388 | (a) 20,364 | (a) 22,041 | (a) 21,197 |
| Nickel contents | " | 4,743 | 9,503 | 10,776 | 10,602 | 9,563 |
| Copper contents | " | 2,163 | 4,525 | 5,260 | 7,003 | 7,501 |
| Value of Nickel | $ | 1,516,747 | 3,354,934 | 3,839,419 | 2,270,442 | 1,866,059 |
| Value of Copper | " | 297,126 | 688,993 | 806,413 | 1,020,913 | 1,062,680 |
| Wages paid | " | 570,901 | 833,822 | 1,117,420 | 1,278,694 | 1,286,265 |
| Men employed | No. | 1,063 | 1,176 | 1,117 | 1,660 | 1,680 |

(a) Bessemer matte.

### A New Nickel Area

An interesting and possibly important discovery was made during the year 1908, being of a deposit of pyrrhotite carrying nickel in apparently workable, even high proportions, outside of the recognized nickel-bearing areas of the Province. Hitherto all known nickel bodies of economic consequence have been confined to the Sudbury field, and while occurrences of nickeliferous pyrrhotite have been noted in other parts of Ontario, they have invariably proven to be too low in nickel to be classed as ore. In the township of Dundonald, near the boundary of Clergue, on lot 1, concession three, a prospector named Alexander Kelso staked out several claims on a body of pyrrhotite which assays showed contained nickel in varying proportions, some samples, it is stated, carrying as high as 11.46 per cent. The deposit is thus described by Dr. A. P. Coleman, who examined it during the spring of 1909:

The latest find of nickel ore in Ontario took place last summer in Dundonald township about four miles west of mileage 222 on the Temiskaming and Northern Ontario Railway. The Alexo mine, as it has been called, has been somewhat developed by test pits and diamond drilling, so that the geological relationships are fairly clear. At present the diamond drilling is being carried on by the Canadian Copper Company, and the following account of the deposit is due to the courtesy of that company:

The region in which the deposit occurs belongs to the so-called "clay belt" of Northern Ontario, where most of the surface is covered with stratified clay or sand when not so low-lying as to be muskeg. The four miles between the railway and the mine are over muskeg followed by gentle sandy or bouldery swells of morainic origin, so that no bed rock is seen till the mine itself is reached. Here a sharp hill of rock rises about a hundred feet above the low ground, and the ore deposit occurs at the foot of the steep northward slope where a swamp extends to the north.

The whole outcrop of rock is less than half a square mile in extent and no rock is known to rise above the surrounding swamps and low sandy ridges for several miles, so that definite knowledge of the geological relationship is at present confined to the immediate surroundings of the deposit.

The hill consists mainly of a hard, fine-grained, fairly silicious rock, locally called quartzite, having the look of certain greatly modified eruptions of the Keewatin. A small amount of granular quartzite has been found in diamond drilling, but the hill itself shows only the sheared and much silicified eruption referred to, apparently an ancient rhyolite or felsite. This varies somewhat in composition, from a bluish

green chert to a fine-grained green or gray rock, containing very little free silica and a good deal of talc or chlorite. Without miscroscopic study this rock cannot be characterized more definitely. Part of the surface shows "pillow structure," suggesting an ancient lava.

On the western side of the hill a broad dike or irregular projection of dark green basic rock penetrates the more acid rock. As it is softer and more easily weathered it is not so well exposed, and occupies the lower ground.

This rock was originally a peridotite, but is now transformed to serpentine, including sometimes very narrow seams of chrysotile (asbestos) like that of the Eastern Townships in Quebec. In places the dark green or black serpentine is spotted with whitish calcite (or dolomite) and forms the rock ophicalcite. No ore nor gossan is found round the margin of this mass of basic eruptive rock, but the ore to the north of the hill is associated with very similar rock, and the two areas are probably connected.

The steep slope of the felsitic rock of the hill on its north side seems to correspond to an original plane of contact with the basic eruption, now completely removed by weathering, since the ore and the associated serpentine lie against its foot in the same attitude below the swamp, as shown by the test pits and diamond drilling.

The materials on the dumps from the two pits include, beside ore itself, serpentine rock thickly spotted with tiny blebs of ore very much like the mixed ore and norite of the Sudbury nickel region. The serpentine of the dumps is often broken into small blocks with slickensided surfaces and thin seams of fibrous serpentine. There are also blocks of ophicalcite like the material found on the hill.

At the most important pit, unfortunately full of water, there are about six feet of pyrrhotite resting against the so-called quartzite, followed to the north by about four feet of mixed ore and rock, beyond which to the north no rock is disclosed. The other pit, a short distance to the west, shows little solid ore, but a greater thickness of the mixed ore and rock. The ore body seems to be lenticular with a well defined foot wall to the south, but no distinct boundary against the serpentine to the north, resembling in this respect the marginal nickel deposits of the Sudbury region.

The ore consists mainly of pyrrhotite, but there is a good deal of copper pyrites in places, especially against the country rock, and also a considerable amount of white iron pyrites. The copper pyrites and iron pyrites appear to have been deposited later than the pyrrhotite.

Much of the ore is very much like that of Sudbury, and an assay of a sample of the pure pyrrhotite, made for the Bureau of Mines, showed 5.79 per cent. of nickel with no copper. Other assays show varying amounts of nickel and copper, the iron pyrites standing lowest. The mixed ore and rock shows by assay an amount of nickel proportionate to its contents of pyrrhotite.

A considerable amount of ore was obtained from the eastern pit, as seen in the ore dump, and the general quality looks very attractive; but the size of the ore body, so far as disclosed in the test pits, is not sufficient to make a profitable mine under present conditions.

How extensive the nickel-bearing serpentine may turn out to be one cannot at present even guess; but much larger areas of the parent rock may exist than have yet been disclosed, and correspondingly large ore bodies may possibly be found at some other point now buried under the widespread mantle of drift which covers the region.

The association of nickeliferous pyrrhotite with serpentine in northern Ontario is of very considerable scientific interest, whether it turns out to be of practical value or not. Thus far our nickel ores have been found with a rather acid variety of norite; but in the Alexo mine they are associated with one of the most basic of known eruptive rocks, serpentine, originally an olivine rock. It is worth while to recall that the nickel ores of our most important rival, New Caledonia, are derived from serpentine, though not by magmatic segregation, as seems to have been the case in the Alexo mine.

The segregated nickel ores of the Scandinavian deposits occur in norite of a more basic kind than that of Sudbury, but far less basic than the serpentine of Dundonald township.

Since the above report was written, the Canadian Copper Company, it is understood, have declined to exercise their option on the property.

There has been again a reduction in the valuation placed upon the nickel contents of the Bessemer matte produced by the mining companies. In 1906 the value was estimated at an average of 17.8 cents per pound, in 1907 10.7 cents per pound, and last year it fell to 9.75 cents per pound. The quotations for refined nickel in 1908 in New York averaged about 43 cents per pound, as against 45 cents per pound in 1907.

In the smelting of the ore into matte the consumption of coke at the nickel works was 64,868 tons valued at $485,219, and the quantity of wood required for roasting the ore was 29,467 cords worth $89,121. For the most part the machinery in the mines and smelting plants is now operated by electrical energy, generated by the Canadian Copper Company at High Falls, Spanish river, and by the Mond Nickel Company at Wabageshik falls on the Vermilion. There is undoubtedly some loss of the metals in roasting and smelting the ores, but without making allowance for such losses, the ore put through the furnaces last year contained 2.65 per cent. of nickel and 2.08 per cent. of copper, as compared with 2.95 per cent. nickel and 1.95 per cent. copper in 1907.

### Copper

The nickel-copper ores of Sudbury constitute the main source of the copper obtained in Ontario, and these deposits being worked primarily for their nickel contents, the production of copper from year to year depends more upon the demand for nickel than for copper itself. Consequently, the low level of copper prices during the past year—the average in the New York market being 13.208 cents per pound, as compared with 20.004 cents per pound in 1907,—had little effect upon the output of the metal in this Province. In fact, the production of 1908 was greater than that of 1907. This was in part due to the higher average copper contents of the ores smelted in the Sudbury furnaces, as compared with the previous year; but the increase in the copper output would have been still greater had prices ruled high, for the non-nickeliferous copper deposits of the north shore of lake Huron and elsewhere were for the most part allowed to remain unworked during 1908. Practically, only one of these mines, the Hermina, raised any ore at all last year. The total production of copper was 7,561 tons, worth $1,071,140, of which all but 60 tons was taken from the nickel-copper ores of the Sudbury field.

### Iron Ore

There were four iron mines from which ore was raised and shipped last year, namely, the Helen mine, Moose Mountain, Mineral Range and Wilbur. The first two are in northern, the last two in eastern Ontario. The total output was 216,177 tons valued at $574,839, as compared with 205,295 tons worth $482,532 in 1907, an increase of 10,882 tons in weight and $92,307 in value. Of the shipments, 166,231 tons was hematite and 49,946 tons magnetite.

Mr. George C. Mackenzie, whose report in the Bureau's seventeenth annual volume gave a comprehensive account of the Iron and Steel industry and iron ore mines of the Province, is continuing his investigations into the applicability of magnetic concentration processes to the low-grade and impure magnetites of Ontario. It was expected that Mr. Mackenzie's conclusions would be published in the present volume, but his experiments have not yet been completed, and the data obtained which, it is hoped, will be of interest and assistance to the iron workers of the Province, will be presented to the public at a later date.

In this Report will be found the concluding reports of Dr. A. P. Coleman and Mr. E. S. Moore on the Iron Ranges of the Nipigon region, also a description by the latter of the bog ore deposits on the English river, together with a brief treatise on the Iron Formations of the Woman River, by Mr. R. C. Allen, of the University of Michigan.

### Pig Iron and Steel

Of the seven blast furnaces in the Province, five were in full campaign during 1908, namely, two belonging to the Algoma Steel Company, Sault Ste. Marie, two to the Hamilton Steel and Iron Company at Hamilton, and one to the Canada Iron Furnace Company at Midland; one, that of the Deseronto Iron Company at Deseronto, was in

operation for a brief space only, while one, the property of the Atikokan Iron Company at Port Arthur, was idle throughout the year. The total production of pig iron was 271,656 tons valued at $4,390,839, a falling off of 14,560 tons in weight and $326,018 in value as compared with 1907. Steel rails to the extent of 126,775 tons, worth $3,353,078, were made by the Algoma Steel Company, and basic open hearth steel by the Hamilton Steel and Iron Company and the Ontario Iron and Steel Company, Welland, amounting to 45,333 tons and valued at $1,044,004.

Hotel in process of construction, Gowganda, February, 1909.

Indian family, Indian Chute, Montreal river.

The Electro-Metals Company, Welland, is operating a plant for the manufacture of ferro-silicon and other ferro compounds.

Mr. J. W. Evans, M.E., of Belleville, who has for some time been experimenting in the production of steel from iron ore by the electric process, writes that in September, 1905, he obtained the first steel made directly from Canadian ores in the electric furnace. This was in the form of steel buttons made in a crucible. Since that time he

had produced mild steel of good quality from Coe Hill ore, containing 68.01 per cent. of iron and 1.01 per cent. of sulphur, and from Bowen mine ore carrying 45.17 per cent. of iron and 7.44 per cent. of titanium. At the date of his letter, 7th June, 1909, Mr. Evans was using ore from the Orton mine, which assayed 52 per cent. of iron, 8 per cent. of titanium and a small amount of nickel, and in one and a half hours from the time the ore was placed in the furnace he obtained steel bars weighing over two pounds. The steel from Coe Hill ore contained from a trace to .04 per cent. of silicon, .08 to .17 per cent. of sulphur, and .05 to .07 per cent. of carbon; from Bowen mine ore, silicon .05 to 2.31 per cent., titanium none to 1.02 per cent. and carbon .51 to .87 per cent. Mr. Evans remarks that in order to retain the titanium in the steel he had to reduce the proportion of lime in the charge, which raised the amount of silicon. In his furnaces he employed a combination of the reflected arc and immersed electrodes as being more economical of electrical energy.

Following are details of the operations at the blast furnaces and steel works during 1908:

| | | |
|---|---|---|
| Ontario ore smelted | tons | 170,215 |
| Foreign " " | " | 342,747 |
| Scale and mill cinder | " | 12,523 |
| Limestone for flux | " | 179,741 |
| Coke for fuel | " | 322,817 |
| Value of do | $ | 1,479,083 |
| Pig iron product | tons | 271,656 |
| Value of do | $ | 4,390,839 |
| Steel product | tons | 172,108 |
| Value of do | $ | 4 397,082 |
| Workmen employed | No. | 1,807 |
| Wages paid | $ | 1,001,893 |

The proportion of domestic ore charged into the blast furnaces rose from 23.6 per cent. in 1907 to 33.1 per cent. in 1908. Much the larger part of the ore raised from the mines of Ontario last year was shipped to furnaces in the Province, although it was not all smelted within the year.

The record of the pig iron and steel manufacturing industry of Ontario during the last five years is shown in the following table :

**Table X.—Production Iron and Steel 1904 to 1908**

| Schedule. | | 1904. | 1905. | 1906. | 1907. | 1908. |
|---|---|---|---|---|---|---|
| Ontario ore smelted | tons | 50,423 | 61,960 | 101,569 | 120,156 | 170,215 |
| Foreign ore smelted | " | 173,182 | 383,459 | 396,463 | 388,727 | 342,747 |
| Limestone for flux | " | 61.566 | 121,052 | 153.702 | 171,037 | 179,741 |
| Coke | " | 135,108 | 262,415 | 304,676 | 326,937 | 322,817 |
| Charcoal | bush. | 1,821,270 | 3,387,869 | 811,926 | 1,849 | .............. |
| Pig iron | tons | 127,845 | 256,704 | 275,558 | 286,216 | 271,656 |
| Value of pig iron | $ | 1.811,664 | 3,909,527 | 4,554,247 | 4,716,857 | 4,390,839 |
| Steel | tons | 51,002 | 138,387 | 167,026 | 237,855 | 172,108 |
| Value of steel | $ | 1,188,349 | 3,321,884 | 4,202.278 | 4,168,127 | 4,397,082 |

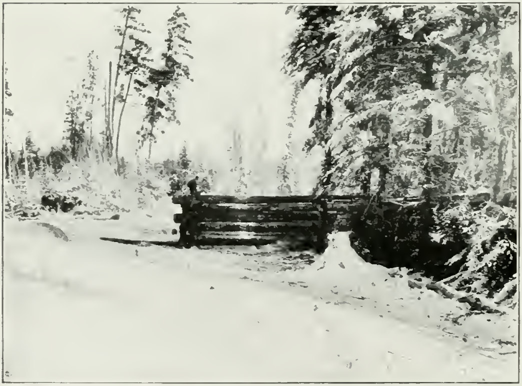
## Materials of Construction

Under this heading are included brick, lime, stone and cement.

### Brick

The production of brick was somewhat smaller in 1908 than in 1907, the total number of the common building variety being 222,361 thousand as compared with 273,882 thousand for the previous year. The average value per thousand also fell off considerably, being $7.09 in 1908, as against $7.70 in 1907. It is quite evident that the

Elkhorn, Gowganda district.



Building a house at Elkhorn.

activity in building operations which characterized very many of the cities and towns of Ontario in 1907 received a decided check last year, and brickmakers anticipating a continuance of this dulness have reduced their output and allowed their stocks to run down. That the price of bricks is still on a higher level than it was six years ago is apparent from the following table. It is indeed probable that the era of cheap bricks has gone, never to return.

| Year. | Price per M. | Year. | Price per M. |
|---|---|---|---|
| 1901 | $5.73 | 1906 | $7.19 |
| 1902 | 6.41 | 1907 | 7.70 |
| 1903 | 6.78 | 1908 | 7.09 |
| 1904 | 7.15 | | |
| 1905 | 7.75 | Average | 6.97 |

The total value of all varieties of brick, including common, fancy, pressed and paving, made last year was $2,123,248. There were 3,084 workmen employed in the brick and tile yards of the Province earning wages aggregating $845,606. That the average period of employment was considerably short of a full year is clear from the fact that the average amount of wages per workman was only $274. In the majority of cases, especially of the smaller yards, bricks are made only during the open season, the larger city yards alone keeping up the production the year round.

#### Drain Tile and Sewer Pipe

Drain tile and sewer pipe, though not strictly materials of construction, are products of the clay industry and are annually made in considerable quantities. Last year the output of tile was valued at $338,658 and of sewer pipe $344,260, as against $250,122 and $435,088 respectively in 1907. There are four sewer pipe manufactories in the Province, as follows, Dominion Sewer Pipe Company, Swansea; Ontario Sewer Pipe Company, Mimico; Milton Pressed Brick and Sewer Pipe Company, Milton; and Hamilton and Toronto Sewer Pipe Company, Hamilton.

#### Lime and Stone

The lime kilns of the Province turned out 2,442,331 bushels of lime last year valued at $448,596, as compared with 2,650,000 bushels worth $418,700 in 1907. The average value per bushel last year was 18 3 cents.

Of building and crushed stone the output in 1908 was valued at $530,041, a decrease from 1907, when the production was worth $675,000

#### Portland Cement

The manufacture of Portland cement in Ontario continues to grow, the production last year being 2,022,877 barrels, an increase of 169,185 barrels over the output for the year previous. The increase in the output was, however, accompanied by a fall in price, the production for 1908 being returned as worth $2,417,769 while that for 1907 was given as $2,777,478. The average selling price per barrel at the factory was therefore $1.195 in 1908 as against $1.498 in 1907, a reduction of $0.303 per barrel.

Fourteen companies manufactured cement last year, the number of plants being fifteen. There were 1,642 men employed in the industry, earning wages to the extent of $645,953. The operating companies were the following:

Lehigh Portland Cement Company, Limited, near Belleville.
Belleville Portland Cement Company, Limited, Belleville.
The National Portland Cement Company, Limited, Durham.
The Superior Portland Cement Company, Limited, Orangeville.

The Hanover Portland Cement Company, Limited, Hanover.
The Ontario Portland Cement Company, Limited, Blue Lake.
Western Ontario Portland Cement Company, Limited, Atwood.
The Canadian Portland Cement Company, Limited, Marlbank and Port Colborne.
The Owen Sound Portland Cement Company, Limited, Shallow Lake.
The Sun Portland Cement Company, Limited, Owen Sound.
The Imperial Cement Company, Limited, Owen Sound.
The Grey and Bruce Portland Cement Company, Limited, Owen Sound.
The Colonial Portland Cement Company, Limited, Wiarton.
The Lakefield Portland Cement Company, Limited, Lakefield.

It was noted in the last Report of the Bureau that the business of making natural rock cement was nearly extinct in this Province, only 7,239 barrels having been made in 1907. Last year the industry went out of existence entirely, not a barrel of the product having been produced at Queenston, Thorold, Limehouse or Hamilton, at all of which places considerable quantities were turned out eight or nine years ago. The manufacture of natural rock cement increased steadily from 46,178 barrels in 1891 to 138,628 barrels in 1901. Since the latter year it has been in a declining condition, the production falling to 14,741 barrels in 1905, to 7,239 barrels in 1907, and finally coming to an end in 1908. The failure of this industry is to be attributed to the increasing severity of the competition from Portland cement, the latter article being now produced and sold at a moderate cost, and being also more uniform in composition and behavior.

In the following table are presented statistics showing the growth and development of the cement industry of Ontario:

### Table XI.—Production of Cement, 1891 to 1908

| Year. | Natural Rock. | | Portland. | | Total. | |
|---|---|---|---|---|---|---|
| | Bbl. | Value. $ | Bbl. | Value. $ | Bbl. | Value. $ |
| 1891 | 46,178 | 39,419 | 2,033 | 5,082 | 48,211 | 44,501 |
| 1892 | 54,155 | 38,580 | 20,247 | 47,417 | 74,402 | 85,997 |
| 1893 | 74,353 | 63,567 | 31,924 | 63,848 | 106,277 | 127,415 |
| 1894 | 55,323 | 48,774 | 30,580 | 61,060 | 85,903 | 109,834 |
| 1895 | 55,219 | 45,145 | 58,699 | 114,332 | 113,918 | 159,477 |
| 1896 | 60,705 | 44,100 | 77,760 | 138,230 | 138,465 | 182,330 |
| 1897 | 84,670 | 76,123 | 96,825 | 170,302 | 181,495 | 246,425 |
| 1898 | 91,528 | 74,222 | 153,348 | 302,096 | 244,876 | 376,318 |
| 1899 | 139,487 | 117,039 | 222,550 | 444,228 | 362,037 | 561,266 |
| 1900 | 125,428 | 99,994 | 306,726 | 598,021 | 432,154 | 698,015 |
| 1901 | 138,628 | 107,625 | 350,660 | 563,255 | 489,288 | 670,880 |
| 1902 | 77,300 | 50,795 | 522,899 | 916,221 | 609,199 | 967,016 |
| 1903 | 89,549 | 69,319 | 695,260 | 1,182,799 | 784,809 | 1,252,118 |
| 1904 | 85,000 | 65,250 | 880 871 | 1,239,971 | 965,871 | 1,305,221 |
| 1905 | 14,741 | 10,402 | 1,254,360 | 1,783,451 | 1,269,101 | 1,793,853 |
| 1906 | 8,453 | 6,000 | 1,598,815 | 2,381,014 | 1,607,268 | 2,387,014 |
| 1907 | 7,239 | 5.097 | 1,853,692 | 2,777,478 | 1,860,931 | 2,782,575 |
| 1908 | ........ | ........ | 2,022,877 | 2,417,769 | 2,022,877 | 2,417,769 |
| Totals | 1,207,956 | 961,451 | 10,180,126 | 15,206,573 | 11,397,082 | 16,168,024 |

#### Prices of Portland Cement

As the manufacture of cement in Ontario has increased the price has fallen, and last year the average cost per barrel at the factory was less than half what it was seventeen years ago. The following figures of cost since 1891 are instructive, showing as they do that while there have been fluctuations from time to time the tendency to a

lower price level has been irresistible, and in 1908 carried the reduction considerably further than in any previous year:

| Year | Price per bbl. at factory. | Year | Price per bbl. at factory. |
|---|---|---|---|
| | $ | | $ |
| 1891 | 2.499 | 1901 | 1.606 |
| 1892 | 2.341 | 1902 | 1.752 |
| 1893 | 2.000 | 1903 | 1.699 |
| 1894 | 2.000 | 1904 | 1.407 |
| 1895 | 1.947 | 1905 | 1.421 |
| 1896 | 1.779 | 1906 | 1.489 |
| 1897 | 1.758 | 1907 | 1.498 |
| 1898 | 1.970 | 1908 | 1.195 |
| 1899 | 1.996 | | |
| 1900 | 1.949 | Average | 1.794 |

## Pottery

The manufacture of pottery from the native clays of Ontario is another branch of the mineral industry which is making little progress. None but the least expensive classes of goods are produced from these clays, such as flower pots, jardinieres, etc., all articles calling for better material and higher finish being either imported or made here from imported clay. The potteries of the Province last year turned out goods having a total value of $50,310. In 1907 the output was valued at $54,585.

Probably not until clays of better quality are discovered than the glacial deposits south of the height of land afford, or until the kaolinic beds of the Moose river and its tributaries are made accessible, will the opportunity be afforded to make the higher grades of crockery and chinaware from raw material found at home.

## Arsenic

The arsenical deposits of Ontario are numerous and extensive. For the most part they consist of arsenopyrite, which as in the case of the ores of the county of Hastings, often carries values in gold. A pretty full account of the arsenic resources of the Province then known was given by Mr. J Walter Wells in the Eleventh Report of this Bureau (pp. 101-122), but since that time the discoveries of smaltite and niccolite at Cobalt and other places in northern Ontario, though primarily valuable for the silver which accompanies them, have considerably enlarged the sources of arsenic supply. As a matter of fact, the only arsenic at present being made in Ontario is refined from the ores of the Cobalt camp, and is therefore, like a large proportion of the arsenic made throughout the world, in reality a bye-product.

There were obtained at the reduction works at Copper Cliff, Deloro and Thorold from silver-cobalt ores last year, a total of 702 tons of refined white arsenic, having a value of $40,373, or say 2.87 cents per pound. In addition, it is estimated that there were 2,970 tons of arsenic contained in the ores which were exported for treatment. Doubtless a large proportion of this arsenic, if not the whole, is recovered in the various plants where the ores are refined, and eventually finds its way to market. The mine owners of Cobalt, however, get nothing for the arsenic contents of their ores, and no figures of value are set opposite these exports of crude arsenic in the tables of production given in this Report. In 1907 the quantity of white arsenic recovered was 348½ tons, and the value as returned to the Bureau was $40,104.

The uses of arsenic are many; it is employed in the manufacture of paints and insecticides, and also in the making of certain grades of glass, to which it imparts a high degree of brilliancy.

## Iron Pyrites

The iron pyrites industry of Ontario is developing. In 1905 the product of the mines was 7,325 tons, in 1907 15,755 tons, and in 1908 20,970 tons valued at $69,980. The larger part of the output is shipped to the United States, but a considerable portion is utilized in the manufacture of sulphuric acid at Sulphide, Hastings county, where the Nichols Chemical Company have an extensive plant.

The producing companies in 1908 were the Northern Pyrites Company, the Nichols Chemical Company, the Northland Mining Company, and the Lake Superior Corporation. The first-named concern made a few trial shipments from their large pyrite bodies at lake Minnitakie, having been afforded an outlet for their product by the completion of the branch line of the Grand Trunk Pacific railway from Fort William. This company has made large preparations for business, and expects to ship extensively to the American market in 1909. The Nichols Chemical Company's mine is at Sulphide in proximity to their acid works; the Lake Superior Corporation exported a small quantity of the granular pyrite found in the Helen iron mine at Michipicoten, and the Northland Mining Company has for some time been working a deposit near Rib lake in the Temagami Forest Reserve.

The Lake Superior Corporation has large deposits of pyrite in the neighborhood of Goudreau lake, southwest of Missanabie on the Canadian Pacific railway, which have not yet been worked, except for testing purposes. A description of these properties will be found in the Sixteenth Report of the Bureau of Mines, pp. 177-180, and also in the Fifteenth Report, pp. 183-187. For a full account of Iron Pyrites in Ontario, reference should be had to the former Report, where the subject is dealt with at length by Mr. E. L. Fraleck.

The following table makes plain the progress which has been made in the mining of iron pyrites in Ontario during the last five years:

### Table XII.—Production of Iron Pyrites 1904 to 1908

| Schedule. | 1904. | 1905. | 1906. | 1907. | 1908. |
|---|---|---|---|---|---|
| Pyrites shipped ....tons | 13,451 | 7,325 | 11,090 | 15,755 | 20,970 |
| Value of do....$ | 43,716 | 21,885 | 40,583 | 51,842 | 69,980 |
| Workmen employed....No. | 60 | 68 | 128 | 137 | 132 |
| Wages paid....$ | 22,875 | 27,690 | 57,580 | 75,365 | 95,740 |

## Mica

From the mica mines of the Province there were raised and shipped last year 368 tons of rough-cobbed amber mica, the value of which was returned to the Bureau as $73,586. This is a decrease from 1907, when the output was 456 tons, worth $82,929.

The principal producers were the Loughborough Mining Company, whose output is utilized by the General Electric Company, and the Dominion Improvement and Development Company. The mines of the former are in the counties of Frontenac and Perth, and of the latter in the county of Perth. Besides these, Kent Bros., of Kingston, (Otty Lake mine), W. L. McLaren, Perth, (N. Burgess), Kent Bros. and J. M. Stoness (Taggart mine), and J P. Tett and Bros., Bedford Mills, contributed to the total.

By far the most important use to which mica is put is in the manufacture of electrical apparatus, where its property of imperviousness to the electric current gives it great value for insulating purposes. The amber mica (phlogopite) of Ontario and Quebec is unexcelled for electrical work. Much of the small material which in former

years was consigned to the dump or was sold as "scrap," is now worked up into micanite, in which pieces of mica of a variety of sizes are by pressure and the use of shellac consolidated into boards or sheets of suitable form and dimensions.

### Salt

There is no rock salt mined in Ontario, the product being entirely the result of the evaporation of brine pumped up from the wells. These are situated on the shores of lakes Huron and St. Clair where immense deposits occur in the limestones of the Onondaga formation.

In 1908 the output of the wells was reported to the Bureau as 79,112 tons valued at $488,330, an increase over the product of 1907, when it was 62,806 tons, worth $432,936. The chief operators were the Canadian Salt Company, with works at Windsor and Sandwich, and the Empire Salt Company of Sarnia. Producers on a smaller scale were Carter and Kittermaster and the Western Salt Company, Mooretown; Ontario People's Salt and Soda Company, Kincardine; Elarton Salt Works Company, Warwick township; Parkhill Salt Company, Parkhill; Gray, Young and Sparling, Wingham; John Ransford, Brussels and Stapleton; Exeter Salt Works Company, Exeter; and Western Canada Flour Mills Company, Goderich. The salt industry gave employment to 195 men, who were paid wages amounting to $93,700.

### Petroleum

The petroleum wells of southwestern Ontario yielded in 1908, 18,479,547 Imperial gallons of crude oil, valued at $703,773.

The falling-off as compared with the previous year was serious, being not less than 33 per cent. on the output of 1907. Part of the decrease may be explained by the gradual diminution in the yield of the wells of Lambton county field. The Petrolea and Oil Springs and Bothwell districts have been producing oil for upwards of forty years and the average production per well is now extremely small, being not over eight or nine gallons per day. It is only the large number of wells, and the economy in management which long experience has taught the operators, that enables Lambton county to be reckoned among the oil-producing regions to-day.

Scrutiny of the figures, showing the production of oil from the various districts, reveals the fact that the decline in yield of the more recent of the oil fields, namely, those in the county of Kent, has been proportionately greater than in the older sections. Whether this comparative rapidity of diminution will continue to characterize the production from Tilbury East and Romney, or whether the fluctuation is of a temporary character and will be compensated by the opening up of fresh pools from time to time, must remain for the future to show.

A statement of the production by districts, kindly furnished by Mr. W. J. Harvey, supervisor of the bounty paid by the Dominion Government on crude petroleum produced in Canada, and covering the last three years, shows the rapid increase and decrease of yield in the new fields, and also the decrease in the older ones:

| Field | Production 1906 | Production 1907 | Production 1908 |
|---|---|---|---|
| | bbl. | bbl. | bbl. |
| Lambton | 377,286 | 304,212 | 265,368 |
| Tilbury and Romney | 106,992 | 411,588 | 201,283 |
| Bothwell | 44'827 | 42,727 | 39,228 |
| Leamington | 39,652 | 6,133 | 9,334 |
| Dutton | 19,376 | 14,977 | 13,743 |
| Thamesville | 175 | 237 | ........ |
| Comber | 651 | ........ | ........ |
| Total | 588,962 | 779,876 | 528,959 |

The first strike of oil in the Tilbury field was made in December, 1905, the second producing well was drilled in March, 1906, and the third in the following month. In Romney oil was struck about the close of 1906, and by the beginning of March, 1907, there were seven producing wells, several of which came in with a yield of over 1,000 barrels each per day.[3] In July, 1907, the Tilbury and Romney wells were in full flow, making about 35,000 barrels of oil, while in November, 1908, seventeen months later, the production had fallen to about 12,000 barrels As will be seen by the figures given above, the yield in the new field rose from 106,992 barrels in 1906 to 411,588 barrels in 1907, falling to less than half the latter quantity in 1908. Of the total decrease from 1907 to 1908, 250,917 barrels, Tilbury and Romney were responsible for 210,305 barrels and Lambton for 38,844. In other words, while the falling-off in Lambton in 1907 compared with 1906 was 19 per cent., and in 1908 compared with 1907, 12 per cent., the drop in Tilbury and Romney from 1907 to 1908 was 51 per cent.

Theoretical explanations of these facts are not very satisfactory. It is asserted by some that the Corniferous limestone which forms the oil reservoir in Lambton county is much more porous than the Onondaga or Guelph limestone which is the oil-holding rock in Tilbury—the Romney pool, which is comparatively small, being also in the Corniferous—and therefore not only holds a larger quantity of oil but parts with it more slowly; further, that the oil in the Tilbury field is really contained in crevices or veins, not in the body of the rock itself, and hence is quickly exhausted. Another view is that new oil fields always vary much more in their production than old fields, for two reasons, (1) the rock pressure of the gas being very strong at first tends to drain the oil rapidly at the outset, (2) in the excitement of a new field there is a good deal of random drilling before the really productive areas are located, hence there is much "temporary production" from the poorer parts of the field, while the good portions will afterwards maintain a fairly steady flow for a considerable time. Moreover, in Lambton the wells being shallow, wells of smaller production can be made to yield a profit, and many hundreds of wells that are still being pumped there and yielding in the aggregate a good deal of oil, would have been abandoned long ago had they been in the Tilbury field, where the oil is at a greater depth and wells are more costly to sink and pump. It is conceded that the pay streaks of the Corniferous limestone in Lambton are more porous than the pay streaks of the Onondaga or Guelph in the Tilbury field, but it is held that all the producing territory in the latter has not yet been found, and it is quite possible that future years may show a larger production there than has yet been made.

A somewhat different classification of the sources of production is made by the Imperial Oil Company of Sarnia, which kindly furnishes the following figures. Comparison is also made between 1907 and 1908:

| Year. | Production 1907. | Production 1908. |
|---|---|---|
| | Imp. Bbl. | Imp. Bbl. |
| Dutton | 14,698 | 12,267 |
| Leamington (Staples, Comber and Blytheswood) | 16,210 | 18,117 |
| Bothwell | 40,556 | 39,820 |
| Richardson (Chatham) | 941 | 2,882 |
| Thamesville | 1,139 | 852 |
| Moore township | 32,720 | 25,666 |
| Oil Springs | 55,813 | 61,251 |
| East Tilbury and Raleigh | 344,358 | 170,588 |
| Romney | 49,783 | 11,164 |
| Petrolea (including all districts not enumerated above) | 206,285 | 171,019 |
| Total | 762,563 | 513,632 |

The net result is pretty much the same, though the estimate of production for both years is somewhat smaller than Mr. Harvey's.

[3] Eugene Coste, in Journal Canadian Mining Institute, March meeting, 1907.

#### Petroleum Prices and Products

The price of crude petroleum in the oil fields of Ontario is regulated by the price paid by the Imperial Oil Company at its various receiving stations. It may cost the producer five to twenty cents a barrel to deliver it, so that the price is not a net one to him. There were practically no fluctuations during the year. The price delivered to the Imperial Company for nearly the first three months was $1.34 per barrel, and for the remainder of the year $1.44 per barrel; the average price therefore for the Petrolea district was $1.41½ per barrel. At producers' tanks in the Tilbury field the price was $1.17 per barrel from 1st January to 15th March, and from 15th March to 31st December $1.27 per barrel. These prices of course do not include the Dominion Government bounty of 51½ cents per barrel. A barrel contains 35 Imperial gallons.

There are two petroleum refineries in the Province, owned and operated respectively by the Imperial Oil Company, Sarnia, and the Canadian Oil Refining Company, Petrolea. Together, these companies distilled 44.675,120 gallons of crude in 1908, so that the domestic product was equal to only 53 per cent. of the total quantity distilled. The remainder was of course imported from the United States.

The following table shows the operations of the petroleum refineries for the last five years:

### Table XIII.—Petroleum and Petroleum Products, 1904 to 1908

| Schedule. | | 1904. | 1905. | 1906. | 1907. | 1908. |
|---|---|---|---|---|---|---|
| Crude produced | Imp. gal. | 17,237,220 | 22,131,658 | 19,928,322 | 27,621,851 | 18,479,547 |
| Crude distilled | " | 22,805,109 | 33,821,998 | 36,134,349 | 34,961,706 | 34,675,120 |
| Value crude produced | $ | 904.437 | 898,545 | 761,546 | 1,049,631 | 703,773 |
| Value distilled products | " | 1,670,805 | 2,196,678 | 2,506,177 | 2,568,464 | 2,347,680 |
| Illuminating oil | Imp. gal. | 11,461,435 | 16,433,588 | 16,125,450 | 18,319,233 | 17,604,920 |
| Lubricating oil | " | 2,683,281 | 3.402,977 | 4,351,818 | 3,931,767 | 3,384,940 |
| Benzine and naphtha | " | 1,488,503 | 2,827,971 | 3,497,954 | 4,132,239 | 3,667,997 |
| Gas and fuel oils and tar | " | 1,962.752 | 5,788,351 | 5,961,834 | 5,632.608 | 4,461,186 |
| Paraffin wax and candles | lb. | 2,272,511 | 4,077,610 | 5,011,467 | 5,132,394 | 5,400,003 |
| Workmen employed | No. | 406 | 469 | 496 | 435 | 430 |
| Wages paid | $ | 229,955 | 280,701 | 308,986 | 265,316 | 247,829 |

### Natural Gas

While the production of petroleum declined, the yield of the allied combustible, natural gas, underwent a decided expansion, and for the first time in the statistical history of the mineral industry of the Province, the value of the natural gas product was greater than that of petroleum, the figures for 1908 being petroleum $703,773, natural gas $988,616. The increase in 1908 over 1907 was $242,117, or 32.4 per cent.

There are three fields in which natural gas is produced in quantity, (1) Welland county, (2) Haldimand county, to which must now be added Norfolk, (3) Essex and Kent. The Welland field produced gas to the value of $343,560 or 34.8 per cent. of the whole, the Haldimand field $535,182 or 54 per cent., and Essex and Kent $109,874 or 11.2 per cent. In 1907 the proportions respectively were 46, 44 and 10 per cent. Haldimaud has now taken the lead, and the prospects are for a still further increase in the production of this district.

The chief producers are: in the Welland district, Provincial Natural Gas and Fuel Company, Buffalo, N.Y.; the Mutual Natural Gas Company, Port Colborne; the United Gas Company, St. Catharines; the Port Colborne-Welland Natural Gas and Oil Company, Port Colborne; Sterling Gas Company, Port Colborne; Welland County Lime works, Port Colborne; Ontario Steel and Iron Company, Welland; Bertie Natural Gas

Company, Ridgeway, and Empire Limestone Company, Buffalo, N.Y.; in the Haldimand field, Dominion Natural Gas Company, Pittsburg, Penn.; Producers' Natural Gas Company, Hamilton; Selkirk Gas and Oil Company, Selkirk; Norfolk Gas Company, Port Dover; and in the Essex and Kent district, Volcanic Oil and Gas Company, Niagara Falls; Leamington Oil Company, Detroit, Mich.; Beaver Oil and Gas Company, Leamington, and Maple City Oil and Gas Company, Chatham.

The following table gives statistics of the natural gas business for the five years beginning with 1904:

**Table XIV.—Natural Gas Production 1904 to 1908**

| Schedule. | | 1904. | 1905. | 1906. | 1907. | 1908. |
|---|---|---|---|---|---|---|
| Value gas produced | $ | 253,324 | 316,476 | 533,446 | 746 499 | 988,616 |
| Producing wells | No. | 176 | 273 | 332 | 582 | 656 |
| Producing wells sunk | " | 36 | 58 | 77 | 161 | 82 |
| Non-producing wells sunk | " | 13 | 5 | 14 | 35 | 21 |
| Delivery pipe | miles | 231 | 461 | 550 | 810 | 850 |
| Workmen employed | No. | 98 | 130 | 108 | 181 | 152 |
| Wa es paid | $ | 53,674 | 88,865 | 64,968 | 110,832 | 106,786 |

### Use and Advantages of Natural Gas

A certain proportion of the gas product is used for industrial and manufacturing purposes, but the larger part is employed for domestic heating and lighting. The latter employment is one for which natural gas is so well fitted, that to use it in brick and lime burning, glass, iron and sugar works, or the generation of steam, seems a perversion of the bounty of nature, especially when, as is usually the case, gas is sold for such purposes at about half the price charged to private users. The drafts that are thus made upon what is after all a limited store simply mean that the people at large will the sooner be deprived of this cleanly, convenient, cheap and efficient fuel.

The advantages which the enjoyment of natural gas for domestic purposes confers upon a community are not readily realized by those who live in less favored places, or even by those who dwell in cities and towns where artificial gas is supplied at ordinary rates. For instance, in the town of Wallaceburg natural gas costs the citizens 25 cents net per thousand feet when used for general heating, or 35 cents net when used for cooking purposes only. Consumers of large quantities for industrial purposes pay only 12 cents per thousand feet. In the town of Leamington the gas is purchased by the town and distributed to the people at a flat rate of two dollars per month for cook stoves, three dollars for house heaters, five dollars for house furnaces, and from three to six dollars per month for stoves or furnaces in stores, etc., the town's receipts from this source being about $20,000 per annum. The cost of natural gas in Chatham is twenty-five cents per thousand feet for domestic consumers, and twelve cents for manufacturers. Similar prices prevail in other places within the reach of the gas fields, tending of course to increase with the distance from the source of supply, on account of the expense and loss of gas in transmission. Outside of the natural gas belt or belts, the people of Toronto have perhaps the cheapest supply of artificial gas in Ontario, and the price they pay is 75 cents net per thousand feet, or three times as much as the people of Wallaceburg, Chatham, and other towns in the gas districts of southwestern Ontario. In other cities and towns, the cost of artificial gas is much higher than in Toronto, rising to at least twice the cost.

### Plugging Abandoned Gas and Oil Wells

Under the Act to Prevent the Wasting of Natural Gas and to Provide for the Plugging of all Abandoned Wells (7 Edward VII., chapter 47), two inspectors have been appointed whose duty is to enforce the plugging of abandoned wells, the object

being to prevent either fresh or salt water entering the gas or oil bearing rock. According to the provisions of the Act anyone interested in any gas or oil lease may report cases of neglect on the part of any operator to the inspector, who is required to investigate and notify the operator to set matters right, if necessary.

One inspector has supervision of the oil fields in Lambton county, the oil and gas territory in Kent and the gas field in Essex; the other has charge of the purely gas fields of Welland and Haldimand-Norfolk. Both of these inspectors are in constant communication with the Department

Mr. John Scott, who is gas and oil inspector for Lambton, Kent and Essex counties, and is stationed at Petrolea, reports that the Act has been well observed with regard to the plugging of abandoned wells. It was not necessary in any case to employ a drilling rig as provided for in the Act, the operators themselves being always willing to put the wells in proper condition.

Petrolea district, with its large number of wells, naturally required the greatest attention. Many of these wells were drilled 25 or 30 years ago, and it was necessary to go over them and to test the casing and to plug leaks.

In some cases, where wells had been put down some years before, it was difficult to find the persons who should attend to the wells not in good order.

Lack of water owing to the dry season curtailed drilling operations considerably. The summer of 1909 will undoubtedly be a busy one in the Kent field.

Mr. John Toyne, Inspector for Welland, Haldimand, Norfolk, and Brant counties. and stationed at the town of Welland, reports that during the year there were 25 new wells drilled in Welland county, 36 in Haldimand and 16 in Norfolk, or 77 in all.

In a very few cases abandoned wells had not been plugged, but this was always remedied after notification.

As there is no oil at all in this field all operators are interested in the gas, and there has been no trouble with regard to waste. Mr. Toyne inspected in all about 800 wells during the year.

As to the wasting of natural gas, the provisions of the Supplementary Revenue Act, 1907, provide a more efficient and readily applied remedy, and the operations of this Act has resulted in an almost entire stoppage of the waste of gas, which in former times characterized the gas fields of Ontario, in common with many other fields on the continent of America. The imposition of a tax of two cents per thousand feet on gas wasted, as well as on that exported, makes it a matter of self-interest on the part of operators to prevent its escape, for the wasting of gas at even two cents per thousand feet is too costly a pastime to be long indulged in.

## Minor Products

Among the lesser items on the list of mineral products of Ontario, apatite or phosphate of lime figures in 1908 for the first time in many years, some 881 tons having been raised of a value of $7,048. The greater part of the output was shipped to Buckingham, Quebec, for the manufacture of phosphorus for the English market, but part was manufactured into fertilizer at Smiths Falls, Ontario. Prices are higher in England than in Canada, and next season producers intend to export to that country. The competition of the cheaper and lower grade phosphates of the southern States has for a long time shut out the richer but more expensive product of Ontario and Quebec.

Corundum, owing to the stoppage of production on the part of the Canada Corundum Company, which has hitherto been the largest producer, shows a considerable falling-off as compared with recent years. This company's business in 1908 consisted mainly in marketing the stock of grain corundum on hand, little fresh rock being raised from the mines.

A plant for the grinding of talc has been erected in Madoc, Hastings county, by Messrs. Geo. H. Gillespie and Company, and began operations in September, 1908. It has a capacity of 400 tons per annum, the product being ground talc of three grades, namely, No. A1 (200 mesh), No. 1 (180-mesh), and No. 2, 3 per cent. retention on 180-mesh. Grade A1 is used by the makers of talcum powder and similar articles, No. 1 by soap makers, tanners and leather manufacturers, and No. 2 by the paper trade and in foundry facings. The product sells at the works at $20 to $25 per ton for No. A1, and $15 to $18 per ton for No. 1, including price of barrels, or $7 per ton for No. 2, including sacks. The bulk of the product grades No. 2.

The remaining items, consisting of calcium carbide, feldspar, graphite, gypsum, and quartz, were produced in about the usual quantities, and do not call for special comment. There was a small production of peat fuel in North Dorchester township, Middlesex county, where J. McWilliam, M.D., of London, has erected a plant.

## Revenue for the Year

The total receipts on account of mining revenue for 1908 were $549,178.94, apparently a heavy decrease as compared with those for 1907, when the amount was $1,731,720.72. It must be borne in mind, however, that the income for 1907 was swelled by two items of an unusual character, paid in on account of the purchase of the beds of Cobalt and Kerr lakes, and amounting together to $1,155,000. Excluding this sum, the revenue for 1908 was only $27,541.78 less than that for 1907. The items are as follows:

| | |
|---|---|
| 1. Sales of mining land | $23,445 30 |
| 2. Leases do | 20,611 81 |
| 3. Licenses, Permits and Recording fees | 137,730 20 |
| 4. Mining Royalties | 218,071 96 |
| 5. Supplementary Revenue Act | 125,078 06 |
| 6. Provincial Mine | 12,592 90 |
| 7. Diamond Drills | 11,286 11 |
| 8. Assay Office, Belleville | 362 60 |
| Total | $549,178 94 |

### Mining Lands

Taking the several items in order, the details of (1) and (2), so far as they apply to transactions originating within the year, are shown in the following statement:

**Table XV.—Mining Lands Sold and Leased in 1908**

| District | Sales | | | Leases | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. | Acres | Amount | No. | Acres | Amount | No. | Acres | Amount |
| | | | $ c. | | | $ c. | | | $ c. |
| Nipissing | 208 | 6,218.8 | 16,300 72 | 12 | 863.88 | 863 88 | 220 | 7,082.68 | 17,164 60 |
| Thunder Bay | 3 | 56.0 | 123 25 | 1 | 316.47 | 316 47 | 4 | 372.47 | 439 72 |
| Sudbury | 7 | 374.8 | 909 50 | 18 | 2,869.37 | 2,829 12 | 25 | 3,244.17 | 3,738 62 |
| Algoma | 10 | 859.4 | 1,359 43 | 4 | 424.10 | 424 10 | 14 | 1,283.50 | 1,783 53 |
| Parry Sound | | | | 6 | 444.00 | 444 00 | 6 | 444.00 | 444 00 |
| Renfrew | 1 | 50.0 | 150 00 | | | | 1 | 50.00 | 150 00 |
| Totals | 229 | 7,559 | 18,842 90 | 41 | 4,917.82 | 4,877 57 | 270 | 12,476.82 | 23,720 47 |

The above does not include rentals received under mining leases issued in previous years, nor sums paid in as purchase money of lands not actually sold and patented within the twelve months. Together, these amounted to $21,336.64.

It will be observed that mining leases are still being issued, notwithstanding that this form of tenure of mining lands was abolished by the changes made in the mining law in 1906, except as regards lands in Forest Reserves. The explanation of this is found in the fact that there are yet a number of applications for mining leases on the files of the Department which for various reasons, principally because of the existence of valuable timber on the lands, have never been completed. Under the provisions of the Mining Act of Ontario, these applications are being dealt with and leases granted as rapidly as the objections disappear.

There is a uniform charge for the sale of mining lands, namely, $2.50 per acre in unsurveyed territory, where the applicant must furnish a plan of survey by an Ontario Land surveyor, and $3.00 per acre in surveyed townships.

#### Licenses, Permits and Recording Fees

As to item (3)—licenses, permits and recording fees—the revenue from these sources is little over one-half the amount for 1907. This is largely accounted for by the reduction in the charge for a miner's license. By an amendment to the Mining Act in 1907 the fee was lowered from $10 to $5, the reduced rate, however, owing to the date at which the amendment became law, having little or no effect until the season of 1908.

A large number of permits to search for minerals in the Temagami Forest Reserve was issued during the year, the charge for such permits being $10 each.

The rise or fall in the revenue from fees imposed by the Mining Act is some index of the activity displayed in prospecting for minerals and taking up mining claims. The excitement created by the discovery of the extraordinarily rich ores of Cobalt in 1903 lasted during 1904, 1905 and 1906, and was augmented in the last-mentioned year by the finds of gold reported from Larder Lake. There was a great deal of prospecting and claim-staking in the Larder Lake region in 1907, and also considerable activity in Cobalt, but in 1908 the former district attracted comparatively little attention, as the ores were found to be on the whole low grade and the precious metal sparsely disseminated, and in Cobalt the productive area was felt to have been pretty well defined. However, the finds of silver made in South Lorrain in 1907, on the banks of the Montreal river in 1906, farther west in the latter region in 1907 and again still farther west in 1908 have served to prolong the interest, and indeed it may be said that at the close of 1908 the excitement caused by the rich specimens of native silver found in the neighborhood of lake Gowganda have not only raised the hopes of prospectors and mining men generally, but have re-inflamed the public mind and paved the way for a recurrence of the Cobalt boom of 1906.

#### Mining Royalties

The details of item 4, mining royalties $218,071.96, are as follows:

| | |
|---|---|
| O'Brien Mine | $109,915 31 |
| Crown Reserve Mine | 29,257 85 |
| Temiscaming and Hudson Bay Mine | 78,898 80 |
| Total | $218,071 96 |

The O'Brien mine pays to the Crown twenty-five per cent. of the value of the shipments of ore, the consignments being valued at the pit's mouth. The agreement between the owners of the mine and the Crown exempts the latter from any part of the cost of underground work, or of hoisting the ore, etc., but in calculating the royalty the surface expenses, such as sorting the ore, haulage and freight, etc., are to be deducted. The difficulty of proportioning exactly these expenses between the parties has led to a modification of the agreement, by which practically the same rate of royalty is payable, while the deductions are more easily and certainly arrived at. A

method of computing the royalty on concentrates is also provided. Up to the end of 1908, the O'Brien mine had contributed in all royalties amounting to $332,860.37.

The arrangement with the Temiscaming and Hudson Bay Mining Company is somewhat different. It provides for the payment to the Crown of a net royalty of fifteen per cent. on the receipts from sales of ore. The amount paid in by this company last year included royalty on past shipments as well as those made in 1908.

In the case of the Crown Reserve mine, the royalty, which is at the rate of ten per cent. on the value of the ore at the pit's mouth, is really part of the purchase price of the property. The history of the sale of this parcel of land by the Crown is interesting. Part of the bed of Kerr lake, in the township of Coleman, which had not been staked out or claimed, as no vein was known to exist upon it, was offered for sale by tender in December, 1906. The highest bid was $52,000, which was not considered sufficient. Tenders were again asked for, and the condition was added that a royalty of ten per cent. should be paid on the value of the ore. The highest offer received in response to the second advertisement was $178,500, which was accepted. A rich vein was struck in developing the mine, and the Crown will probably receive at least as much by way of royalty as the original price.

There are several other properties charged with payment of royalty direct to the Department of Lands, Forests and Mines, exclusive of those which contribute royalties to the Temiskaming and Northern Ontario Railway Commission. They include the Hargrave locations, 25 per cent., Chambers-Ferland properties, 25 per cent., and Scully claims, 10 per cent. None of these paid anything in 1908, but the Chambers-Ferland Company will be a contributor in 1909.

The total receipts from mining royalties up to the end of 1908 were as follows:

| | |
|---|---|
| O'Brien mine | $332,860 37 |
| Crown Reserve mine | 29,257 85 |
| Temiscaming and Hudson Bay mine | 78,898 80 |
| Total | $441,017 02 |

Item 5 includes all revenues arising under the Supplementary Revenue Act, 1907. They are of three kinds, the several amounts being as follows:

| | |
|---|---|
| Profit tax | $100,538 57 |
| Gas tax | 15,037 02 |
| Acreage tax | 9,502 47 |
| Total | $125,078 06 |

Mr G. R. Mickle, M.E., Mine Assessor under the Supplementary Revenue Act, furnishes the following information respecting the operation of that Act during 1908:

Under this Act three different kinds of taxes are levied, viz: (1) A tax of three per cent. on the profits of mines operated in Ontario in excess of $10,000, certain deductions being allowed for taxes paid the municipality in which the mine is situated, the method by which the profit is to be computed being laid down in the Act: (2) A tax of two cents per thousand cubic feet of natural gas produced, 90 per cent. of which is rebated if the gas is used in Canada: and (3) An acreage tax of two cents per acre on land patented or leased as mining land and situated in territory having no municipal organization. These taxes became due for the year 1907 on the 1st December, 1907, consequently a considerable portion of the tax for that year was not received till early in 1908, and was credited in the Provincial Treasurer's statement to the year 1908. After 1907 all taxes become due on 1st October each year, and practically all the profit and gas tax for 1908 was paid in before the end of the calendar year. As the financial year for the Province now ends with the 31st October, there will undoubtedly always be some small amount of the taxes due in each year which will not be paid until the next financial year, and therefore there will always be some discrepancy

between the Treasurer's statement, which takes account only of payments made within the financial year, and the one where the tax is credited to the year where it properly belongs.

On this latter basis the total amount received for the year 1908 was $90,717.76, an increase of about six thousand dollars over 1907.

The distribution is as follows:

| | |
|---|---|
| (1) Profit tax | $65,922 48 |
| (2) Gas tax | 13,454 51 |
| (3) Acreage tax, (paid from 15th April, 1908, to 15th April, 1909) | 11,340 77 |
| Total | $90,717 76 |

The increase is almost entirely in the acreage tax, due to the fact that many holders of land were not aware of the tax till notified in 1908.

The amount collected under the profit tax is from fifteen different companies, eleven of which operate silver mines in the Cobalt district. Those mines in this district which, under special agreements pay royalties to the Crown, are freed from this tax. Also, those properties leased from the Temiskaming and Northern Ontario Railway Commission have not been required to pay the tax. This eliminates a number of good properties from the list of tax-payers. The deduction allowed for tax on income paid the municipalities also reduces the profit tax seriously.

The outlying districts in the Temiskaming division may be expected to furnish some revenue from this source in the future.

Next in importance as a revenue producer to the silver mines come the copper-nickel mines of Sudbury district. In addition to these, one company mining and exporting a portion of its iron ore and one operating mica mines paid a tax. Several companies which mine gold ore, and also several operating or preparing to operate pyrite ore, appear to have a chance to become contributors to the profit tax in the future.

Thirty-six different companies or individuals owning natural gas wells paid the amount mentioned above as derived from gas. Of this sum, $6,249.28, or about 46 per cent. of the total received was the amount levied on gas exported or wasted. There is also over $300.00 in taxes on gas wasted, which is being collected through the courts. The waste of gas during the year 1908 was trifling compared to 1907, no very serious waste having lasted any length of time.

The results obtained by drilling operations for gas in the County of Kent particularly, have been very encouraging. The developments in the western end of the older Welland-Haldimand-Norfolk field have also been satisfactory.

As exportation of gas is now shut off entirely and wasting is too expensive, the revenue from natural gas must drop in spite of increased production.

In order to appreciate the acreage tax and the distribution of the areas under taxation, it is necessary to understand the regulations under which mining lands have been granted from time to time in the Province. Two different and conflicting principles appear to have been followed in disposing of the mining lands belonging to the Crown, namely; the plan of selling outright large areas called "mining locations" to the first applicant without stringent conditions of any kind, and, later, the principle of setting aside certain areas or "divisions," as they were called, in which a licensee might acquire exclusive rights to a small area called a "mining claim" by performing a certain amount of work.

For over fifty years the former plan was in force, the area which might be acquired by direct purchase being reduced from time to time, while the size of the mining claim was constantly increased. Thus at first the minimum area which might be granted was 10 square miles, or 6,400 acres, the first patent of land as mining land which was issued in 1852 being for about 6,400 acres. In 1853 the regulations were changed so that a smaller location of 400 acres might be taken. The large locations of 6,400 acres were still retained till 1869. During this period 132,685 acres were alienated in locations of 6,400 acres, more or less, which still appear on the tax roll, and about 35,000 acres in the 400-acre blocks.

In 1864 the mining division, in which claims of small area might be acquired and held by work without purchase, first appears. These claims had an area of less than one acre, the idea being evidently taken from the practice in other countries governing alluvial gold deposits.

Passing through successive changes to the Act of 1897, the "location" was reduced to a minimum size of 40 acres, and a maximum of 320 acres, and the "claim" increased to a maximum of 40 acres. By the Act of 1906 the whole Province is divided into mining divisions, and consequently there can be no more "locations," but only "claims," which have a maximum area of 40 acres, except in "special" mining divisions.

Most of the land now taxable under the Supplementary Revenue Act was granted in large blocks as "locations." Only a very small number of the "claims" staked under the Act of 1906 have been patented, as the land can be held three years and six months without purchasing, provided the working conditions are fulfilled.

In preparing the acreage tax roll, giving a list of all the lands taxable under the Supplementary Revenue Act, the judicial districts have been followed in dividing up the Province, as these would be less liable to change than the mining divisions.

The taxable areas in the respective districts are as given below:

| | Acres. |
|---|---|
| Rainy River District | 190,545 |
| Thunder Bay District | 413,770 |
| Algoma District | 121,031 |
| Sudbury District | 80,868 |
| Nipissing District | 14,284 |
| Parry Sound and Muskoka Districts | 13,314 |
| Total | 833,812 |

Many of the locations granted in large blocks in times of excitement in the various districts will no doubt pass back to the Crown when the time for forfeiture arrives. This will be the 30th June or 31st December, 1910. The owners have in many instances disappeared or lost all interest in the property.

#### Receipts from Provincial Mine

Item 6, $12,592.90, with the exception of $275.57, is the amount realized from sales of ore from the Provincial mine, situated on the Gillies timber limit. The deposit upon which the opening was made while containing silver has not so far been productive of any large quantity of rich ore. One carload of silver ore and two carloads of cobalt ore were sold, the former to the Deloro Mining and Reduction Company, Deloro, and the latter, one to the Anglo-French Nickel Company of Swansea, Wales, and the other to the Coniagas Reduction Company, Thorold, Ontario. Following are the details:

| | |
|---|---|
| April 10, car C. P. 29970, sold Coniagas Reduction Company, Thorold, 42,028 lbs. cobalt ore, 8.045 per cent. Co. at 35c. per lb., Net | $1,188 18 |
| May 28, sold Anglo-French Nickel Company, Swansea, 50,075 lbs. cobalt ore, 10.62 per cent. cobalt, at 40c. per lb., Net | 2,101 74 |
| July 9, car 5827, sold Deloro Mining & Reduction Company, Deloro, 48,625 lbs. ore, assaying 783.17 oz. silver, 8.18 per cent. cobalt per ton, and 31.46 per cent. arsenic; Silver 52¼c. per ounce, for 75 per cent., and 53¼c. for 25 per cent., cobalt $10 per ton of ore, and arsenic 1c. per lb., Net | 9,027 41 |
| Total | $12,317 33 |

Item 7, $11,286.11, represents the sums paid by persons who obtained the services of the Government diamond drills, 65 per cent. of the expense of working being borne by the person getting the drill and 35 per cent. by the Department.

Item 8, $362.60, comprises the fees remitted by the Assay Office, Belleville, for assays, analyses, etc., made for prospectors and others during the year. Owing to a considerable portion of the collections reaching the Department after the books for the year had been closed, the amount appears much smaller than it really was.

## Mining Companies Incorporated in 1908.

The number of mining companies incorporated under the laws of Ontario in 1908 was 184, with an aggregate authorized capital of $123,526,500, as compared with 321 companies having a nominal capital of $319,876,000 in 1907. There were 8 companies of foreign incorporation licensed to do business in Ontario, their combined capital amounting to $1,890,000; besides 11 companies incorporated under the laws of Canada.

Following is a list of the incorporations:

| Name of Company. | Head Office. | Date of Incorporation. | Capital. |
|---|---|---|---|
| | | | $ |
| Aaba Cobalt Mines, Limited | Haileybury | April 16 | 1,000,000 |
| Agaunico Mines Development Company, Limited | Toronto | June 15 | 40,000 |
| Algoma Development Company, Limited | Toronto | September 4 | 150,000 |
| American Drummer Cobalt Silver Mining Company, Lim'd. | Toronto | February 3 | 500,000 |
| Argentum Mines, Limited | Toronto | December 2 | 1,000,000 |
| Aureole Mining Company, Limited | Ottawa | February 29 | 40,000 |
| Badger Mines Company, Limited | Toronto | October 27 | 2,500,000 |
| Bell's Lake Portland Cement Company, Limited | Toronto | June 15 | 450,000 |
| Black Donald Graphite Company, Limited | Calabogie | March 20 | 40,000 |
| Cable Silver Cobalt Mines, Limited | Toronto | December 22 | 2,000,000 |
| Canada Imperial Mines Limited | Toronto | December 29 | 40,000 |
| Canadian Oil Companies, Limited | Toronto | December 4 | 2,005,000 |
| Central Canada Mining Company, Limited | Ottawa | July 13 | 1,200,000 |
| Chambers-Ferland Mining Company, Limited | Toronto | June 12 | 2,550,000 |
| Chown Lake Cobalt Mines, Limited | Toronto | November 4 | 75,000 |
| Cobalt Leasers, Limited | New Liskeard | October 23 | 1,000,000 |
| Cobalt Silver Hill Mines, Limited | Cobalt | February 3 | 500,000 |
| Cobalt Station Grounds Mining Company, Limited | Ottawa | October 23 | 1,000,000 |
| Cobalt Treasure Mining Company, Limited | Toronto | November 24 | 750,000 |
| Colonial Cobalt Development Company, Limited | Toronto | December 30 | 1,000,000 |
| Consolidated Exploration Company, Limited | Toronto | May 28 | 1,250,000 |
| Corona Cobalt Silver Mining Company, Limited | Toronto | November 10 | 1,100,000 |
| Darby Mines, Limited | Toronto | November 5 | 50,000 |
| Darby Mountain Mining Company, Limited | Haileybury | June 19 | 40,000 |
| Dominion Development and Mining Company, Limited | Toronto | November 21 | 500,000 |
| Dumond Gold Mines Company, Limited | Dunnville | February 14 | 1,000,000 |
| Eastbourne Cobalt Mines, Limited | Toronto | October 9 | 40,000 |
| Elklake-Cobalt Mines of Ontario, Limited | Toronto | November 12 | 150,000 |
| Excelsior Mica Mines, Limited | Toronto | July 17 | 40,000 |
| Exploration Syndicate of Ontario, Limited | Toronto | December 21 | 150,000 |
| Gifford Cobalt Mines, Limited | Toronto | October 23 | 350,000 |
| Gifford Extension Mines, Limited | Toronto | November 16 | 500,000 |
| Gold Leases, Limited | Toronto | April 27 | 500,000 |
| Gow Ganda King Silver Mines, Limited | New Liskeard | October 23 | 1,000,000 |
| Gowganda Lake Mining Company, Limited | Toronto | November 2 | 1,000,000 |
| Gow Ganda Mines, Limited | Toronto | November 3 | 1,500,000 |
| Gow Ganda Queen Mines, Limited | Toronto | December 21 | 40,000 |
| Granite Crushed and Dimension, Limited | Toronto | April 3 | 40,000 |
| Halton Oil and Gas Company, Limited | Milton | August 19 | 500,000 |
| Hyland Silver Mining Company, Limited | Ottawa | July 8 | 1,000,000 |
| Imperial Copper-Nickel Co., Limited | Toronto | July 8 | 1,000,000 |
| Imperial-Crown Mines, Limited | Toronto | November 10 | 4,000,000 |
| Imperial Gold Mines, Limited | Toronto | January 6 | 100,000 |
| Irene Mines, Limited | Toronto | September 24 | 200,000 |
| Iroquois Silver Mining Company, Limited | Toronto | December 17 | 2,500,000 |
| Keeley Mine, Limited | Toronto | December 2 | 1,000,000 |
| Lady of the Lake Mining Company, Limited | Windsor | September 28 | 50,000 |
| Larder Lake Incline Mines, Limited | Toronto | May 11 | 250,000 |
| Lemieux Silver Mines, Limited | Toronto | October 27 | 000,000 |
| Lucky Godfrey Cobalt Mines Company, Limited | Ottawa | September 28 | 1,250,000 |
| McCrimmon Montreal River Mines, Limited | Alexandria | December 10 | 300,000 |
| McKay Mining Company, Limited | Sault Ste. Marie | October 27 | 750,000 |
| McKenzie Mining and Exploration Company, Limited | Toronto | November 12 | 400,000 |
| Magnet Mines Company, Limited. | Pembroke | April 16 | 1,150,000 |
| Maidens Silver Mining Company, Limited | Haileybury | April 16 | 500,000 |
| Manufacturers Corundum Company, Limited | Toronto | December 7 | 100,000 |
| Maple Leaf Mines, Limited | Toronto | November 7 | 150,000 |
| Marcell Mines, Limited | Haileybury | November 5 | 500,000 |
| Marvel Silver Mines, Limited | Toronto | July 27 | 200,000 |
| Midfield Natural Gas Company, Limited | Hamilton | December 17 | 40,000 |
| Miller Lake and Everett Mines, Limited | Toronto | October 13 | 100,000 |
| Mines and Exploration, Limited | Cobalt | November 12 | 40,000 |
| Montreal River Cobalt Silver Mines, Limited | Latchford | October 28 | 200,000 |
| Montreal River Consolidated, Limited | Toronto | December 11 | 500,000 |
| Mount Royal Consolidated Mines, Limited | Toronto | November 30 | 3,000,000 |
| Munro Mines, Limited | Guelph | December 11 | 750,000 |
| New Ontario Finance Syndicate, Limited | Ottawa | October 9 | 75,000 |
| Nipissing Diamond Drilling Company, Limited | Cobalt | December 4 | 50,000 |
| Nipissing Reduction Company, Limited | Toronto | April 1 | 250,000 |
| Northern Discovery Company, Limited | Bracebridge | April 10, 1907 | 40,000 |

## Mining Companies Incorporated in 1908—Continued

| Name of Company. | Head Office. | Date of Incorporation. | Capital. |
|---|---|---|---|
| | | | $ |
| Northern Star Mining & Development Company, Limited | Ottawa | May 15 | 100,000 |
| Ontario Development and Mining Company, Limited | Cobalt | October 26 | 500 000 |
| Ontario Development Company, Limited | Toronto | June 6, 1907 | 25,000 |
| Ontario Limestone and Clay Company, Limited | Belleville | February 17 | 50,000 |
| Ophir Cobalt Mines Limited | Cobalt | November 16 | 500,000 |
| Otisse-Currie Consolidated Silver Mines, Limited | Toronto | October 5 | 1,500,000 |
| Otisse Mining Company, Limited | Toronto | September 24 | 2,000,000 |
| Otto Lake Mining Company, Limited | London | March 20 | 500,000 |
| Oxford Oil and Gas Company, Limited | Brantford | August 12 | 250,000 |
| Peerless Brick and Tile Company, Limited | Ottawa | April 10 | 150,000 |
| Pennsylvania Lumber and Mineral Company, Limited | Toronto | March 9 | 100,000 |
| Point Anne Quarries, Limited | Toronto | November 23 | 500,000 |
| Prudential Mines, Limited | Toronto | December 29 | 2,000,000 |
| Quaker City-Cobalt Mines, Limited | Haileybury | March 18 | 1,000,000 |
| Red Jacket Silver Mines, Limited | Toronto | November 12 | 1 250,000 |
| Roswell Silver Mining Company, Limited | Toronto | May 1 | 1,000,000 |
| Sharpe Lake Mines, Limited | Haileybury | March 2 | 120,000 |
| Silver Alliance Mines, Limited | Toronto | December 2 | 1,000,000 |
| Silver Crescent Mining Company, Limited | Windsor | December 2 | 100,000 |
| Silver Elk Mines, Limited | Toronto | June 6 | 100,000 |
| Silver Lake Mining Company, Limited | Toronto | October 22 | 1,000,000 |
| Silver Lode Mines, Limited | Windsor | September 16 | 1,000,000 |
| Silvers, Limited | Toronto | November 21 | 2,000,000 |
| Sonora Mining Company, Limited | Owen Sound | December 18, 1907 | 2,500,000 |
| Strathcona Nickel Mines, Limited | Sault Ste. Marie | March 16 | 250,000 |
| Temagami-Cobalt Mines of Ontario, Limited | Toronto | November 4 | 40,000 |
| Temagami Gold Reefs Company, Limited | Toronto | May 8 | 500,000 |
| The Aedus Mineral Company, Limited | Ottawa | January 17 | 500,000 |
| The Alpine Mining Company, Limited | Ardoch | April 13 | 300,000 |
| The Americana Cobalt Silver Mining Company, Limited | Cobalt | September 30 | 1,000,000 |
| The Bay Lake and Montreal River Mining and Development Company, Limited | Sault Ste. Marie | January 6 | 300,000 |
| The Big Fissure Mining Company, Limited | Toronto | March 30 | 2,000,000 |
| The Big Moose Silver Cobalt Mining Company, Limited | Toronto | April 1 | 750,000 |
| The Boundary Coal Mining Syndicate, Limited | Toronto | December 2 | 125,000 |
| The Brant Portland Cement Company, Limited | Brantford | March 20 | 500,000 |
| The Breeches Lake Mining Company, Limited | Ottawa | March 23 | 500,000 |
| The Bruce Mines, Limited | St. Catharines | October 27 | 500,000 |
| The Canadian Lead Mining & Smelting Company, Limited | Kingston | July 13 | 400,000 |
| The Cobalt-Rosario Mining Company, Limited | Toronto | November 26 | 1,000,000 |
| The Cobalt Silver Producer Company, Limited | Toronto | December 24 | 400,000 |
| The Consolidated Gold and Silver Mines of Elk and Larder Lake, Limited | Toronto | May 8, 1907 | 3,000,000 |
| The Crysler Niles Mining Company, Limited | Toronto | October 9 | 1,500,000 |
| The Crystal Gold Mining and Milling Company of Wahwapitae, Limited | Toronto | June 6 | 500,000 |
| The Devlin Mining Company, Limited | Ottawa | December 17 | 500,000 |
| The Elkhart Proprietary Silver Mines, Limited | Haileybury | March 2 | 100,000 |
| The Elkhorn Mining Company, Limited | Galt | September 24 | 100,000 |
| The Elk Lake Discovery Mines, Limited | Toronto | October 27 | 600,000 |
| The Excelsior Cobalt Larder Lake Mining Company, Limited | Niagara Falls | February 3 | 1,000,000 |
| The Farah Mining Company, Limited | Toronto | November 10 | 2,000 000 |
| The Forneri Mining Company, Limited | Toronto | October 30 | 1,000,000 |
| The Gavin Hamilton Mining Company, Limited | Toronto | December 17 | 1,500,000 |
| The Gilt Edge Silver Mining Company, Limited | Ottawa | December 22 | 1,000,000 |
| The Gow Ganda United Cobalt Mines Company, Limited | New Liskeard | December 29 | 1,000,000 |
| The Great West Coal Company, Limited | Port Arthur | January 21 | 250,000 |
| The Hamilton Brick Company, Limited | Toronto | June 26 | 40,000 |
| The Hargrave Silver Mines, Limited | Toronto | November 3 | 2,500,000 |
| The Holmes Cobalt Silver Mining Company, Limited | Windsor | April 16 | 500,000 |
| The Holmes Gas Company, Limited | Selkirk | September 16 | 40,000 |
| The Imperial Otto Mining Company, Limited | Hamilton | February 3 | 250,000 |
| The Keeley Jowsey Wood Mine, Limited | Toronto | May 28 | 1,000,000 |
| The King George Mining Company, Limited | Ottawa | March 11 | 750,000 |
| The Lambton Pressed Brick Company, Limited | London | June 29 | 50,000 |
| The Last Chance Mining Company, Limited | Toronto | August 5 | 40,000 |
| The Loughborough Mica Company, Limited | Toronto | February 7 | 40,000 |
| The Lyon Mining Company, Limited | Toronto | November 16 | 40,000 |
| The Marble Lake Mining and Milling Company, Limited | Niagara Falls | September 18 | 500,000 |
| The Miller Lake Mining Company, Limited | Sydenham | October 5 | 100,000 |
| The Mines Finance Company of Canada, Limited | Toronto | December 2 | 250,000 |
| The Mississagua Development Company, Limited | Thessalon | November 26 | 9,000 |
| The Montreal River Development Company, Limited | North Bay | August 18 | 40,000 |
| The Mother-Lode Mining Company, Limited | Windsor | April 13 | 1,000,000 |
| The Mount Royal Cobalt Silver Mining Company, Limited | Cobalt | November 19 | 2,000,000 |
| The Norfolk Gas Company, Limited | Port Dover | February 28 | 60,000 |
| The North-Lanark Marble and Granite Quarries, Limited | St. Catharines | September 2 | 150,000 |
| The Oliphant Oil and Gas Company, Limited | Listowel | December 2 | 22,500 |
| The Oneida Lime Company, Limited | Hamilton | February 7 | 20,000 |
| The Ontario Gas and Oil Fields, Limited | Ottawa | January 25 | 1,000,000 |

## Mining Companies Incorporated in 1908.—Continued

| Name of Company. | Head Office. | Date of Incorporation. | Capital. |
|---|---|---|---|
| | | | $ |
| The Ontario Marble Quarries, Limited | Bancroft | May 18 | 500,000 |
| The Ontario Silica Company, Limited | Windsor | August 14 | 100,000 |
| The Ott Brick and Tile Manufacturing Company, Limited | Berlin | December 2 | 40,000 |
| The Pan Silver Mining Company, Limited | Haileybury | October 9 | 3,000,000 |
| The Phœnix Oil and Gas Company, Limited | Milverton | August 21 | 100,000 |
| The Pioneer Exploration Company, Limited | Englehart | September 18 | 10,000 |
| The Pontiac Silver Mining Company, Limited | Toronto | December 11 | 1,000,000 |
| The Rawhide Mines, Limited | Toronto | December 21 | 1,000,000 |
| The Regal Mining Company, Limited | Windsor | September 11 | 1,000,000 |
| The Rose Gold and Silver Mining Company, Limited | Ottawa | October 23 | 1,500,000 |
| The Ross-Ballard Mining Company, Limited | Ottawa | September 11 | 100,000 |
| The St. Catharines Brick and Tile Company, Limited | St. Catharines | March 11 | 60,000 |
| The St. Clair Oil Company, Limited | Toronto | August 5 | 100,000 |
| The Silver Maple Mines, Limited | Toronto | December 21 | 100,000 |
| The Smith's Falls Pressed Brick Company, Limited | Smith's Falls | August 25 | 75,000 |
| The Soo Copper Company, Limited | Windsor | February 7 | 1,000,000 |
| The South-Lorrain Development Company, Limited | Haileybury | December 2 | 500,000 |
| The Swastika Mining Company, Limited | Toronto | January 6 | 750,000 |
| The Titan Montreal River Mines, Limited | Toronto | November 17 | 2 000,000 |
| The Toronto and Niagara Carbide Company, Limited | Toronto | May 18 | 100,000 |
| The Toronto-Brazilian Diamond and Gold Dredging Company, Limited | Toronto | July 17 | 1,000,000 |
| The Transcontinental Silver Mines, Limited | Cobalt | December 4 | 200,000 |
| The Trinity-Cobalt Mining Corporation, Limited | Haileybury | May 22 | 100,000 |
| The United Oil Fields, Limited | Toronto | June 19 | 100,000 |
| The Unnm Cobalt Mining Company, Limited | Windsor | June 12 | 400,000 |
| The Verner Silver Mining and Development Company, Limited | Haileybury | October 23 | 100,000 |
| The Vipond Mining Company, Limited | Haileybury | March 25 | 1,000,000 |
| Toledo Silver Mines, Limited | Toronto | December 9 | 1,000,000 |
| Toronto Indestructible Brick Company, Limited | Toronto | February 19 | 100,000 |
| Twin City Coal Company, Limited | Toronto | May 28 | 600,000 |
| Ulrica Mines Company, Limited | Toronto | March 18 | 1,000,000 |
| Vulcan Gold Mines, Limited | Ottawa | September 28 | 300,000 |
| Wabishonia Cobalt Mining Company, Limited | Toronto | December 2 | 100,000 |
| Watash Cobalt Mines, Limited | Toronto | December 2 | 1,500,000 |
| West Coleman Silver Mines, Limited | Haileybury | March 2 | 750,000 |
| Wettlaufer Lorrain Silver Mines, Limited | Toronto | November 30 | 1,500,000 |
| White's Bonanza Lode Mining Company, Limited | Toronto | June 19 | 50,000 |
| Total | | | 123 526,000 |

## Mining Companies Licensed in 1908

| Name of Company. | Provincial Head Office. | Date of License. | Capital. |
|---|---|---|---|
| | | | $ |
| Adrian-Wolverine Oil Company | Leamington | April 23 | 15,000 |
| Boston International Oil & Mining Company | Chatham | January 17 | 40,000 |
| Canada Mineral Waters, Limited | Ottawa | March 6 | |
| Canadian Exploration Company, Limited | Toronto | November 19 | |
| Canadian Gypsum Company, Limited | Toronto | April 23 | |
| H. J. Mining Company | Sault Ste. Marie | November 19 | 5,000 |
| Lake Superior Gold and Copper Company, Limited | Toronto | September 9 | |
| Mineral Development Company, Limited | Toronto | April 29 | |
| Nova Scotia Cement and Plaster Company, Limited | Toronto | March 30 | |
| Ontario Copper and Smelting Company | Toronto | October 28, 1907 | 250,000 |
| St. John's Temagami Gold & Silver Mining Company, Limited | Toronto | March 11 | |
| The Alberta Portland Cement Company, Limited | Toronto | December 24 | |
| The Alexandra Mining Company | Haileybury | November 21, 1906 | 1,000,000 |
| The Coniagas Reduction Company, Limited | St. Catharines | November 5 | |
| The Dominion Nickel Copper Company, Limited | Ottawa | January 17 | |
| The Raven Lake Mining & Development Company, Limited | Ottawa | May 17, 1907 | |
| The Syracuse Mining and Development Company | Haileybury | December 4 | 40,000 |
| The Union Sulphur Company | Toronto | December 23, 1907 | 40,000 |
| Waltham-Ontario Oil Producing Co | Chatham | September 9 | 500,000 |

## The Mining Divisions

The mineral lands of the Province are administered by the Department of Lands, Forests and Mines through the Recorders of the several Mining Divisions into which the Province is divided.

This system, which the amendments to the mining law in 1906 extended to the whole of the Province, is proving itself flexible and convenient. It is not without its disadvantages, for it cannot be expected that business involving great detail and much vigilance will always be transacted without mistake or omission, especially in the midst of such excitement as always follows upon a discovery of rich ground, and in new and remote districts, in all probability not only unsurveyed but entirely unmapped, and with which communication by telegraph is impossible and by mail slow and uncertain. The lack of accurate maps is the source of considerable difficulty when a new and unexplored region is found to contain valuable mineral.

Prospectors' measurements and directions are seldom exact, and the Recorder finds it difficult to lay down on his map mining claims situated in unsurveyed territory in such a way as to show their relation to one another, or to the nearest base or meridian line, or even to an adjacent lake or river. But presently the claim holders, having completed their "assessment" work, begin to apply for their titles. This necessitates an instrumental survey, and the land surveyor establishes the corners and fixes the boundaries of a few claims here and there, "tying" them to some previously surveyed point or line, and thus enabling perhaps a large group of claims to be located with some precision by the Recorder on his map.

Other difficulties beset the Recorder in a new mining district, but the conveniences which the system of local administration affords to prospectors and the mining community generally are such as to outweigh all its disadvantages; and indeed, it is not easy to see how the hundreds and thousands of applications for mining lands in Temiskaming at the height of the Cobalt "boom," or at the present time in the wilds of Gowganda, could be satisfactorily dealt with, without some one on tho spot clothed with authority to settle disputes and determine difficulties generally.

### The Improved Mining Law

Sufficient time has now elapsed to enable some judgment to be passed upon the working of the radical amendments made to the Mining Act in 1906. On the whole, they have proven satisfactory. Requiring the development work to be done before patent is issued, and not afterwards, as was formerly the case; limiting the area of a mining claim to 40 acres, where 320 acres was previously the maximum; de-centralizing the administration of mining lands; and the appointment of a Mining Commissioner with power to settle disputes on appeal from the Recorders, are all features that have proved their worth, and none of them in a greater degree than the one last named.

Under any conceivable system of mining law, disputes are bound to arise, and the richer the discoveries the keener are the disputes and the greater the number. The establishment of a special tribunal for the hearing and settlement of such disputes, with frequent sittings held at places most convenient for the parties, has made it possible to decide the great majority of disputes within a short time of their occurrence. In some classes of cases the Commissioner's ruling is final, but in important matters where valuable interests are involved, appeal may be taken to the Court of Appeal. The right of such appeal has not so far been largely availed of, and where exercised, the final decision has usually sustained the Commissioner's judgment.

Following is a table of the Mining Divisions of the Province, with the name and address of the Recorders, and the receipts of the several offices for the year 1908:

### Table XVI.—List of Mining Divisions

| Mining Division. | Name and P.O. Address of Recorder. | Receipts. | | | Total receipts. |
|---|---|---|---|---|---|
| | | Purchase money. | Miner's licenses. | Recording fees, etc. | |
| | | $ | $ | $ | $ |
| Kenora | C. W. Belyea, Kenora | 399 00 | 592 00 | 773 35 | 1,764 35 |
| Port Arthur | J. W. Morgan, Port Arthur | 2,416 00 | 2,416 00 | 4,543 00 | 9,375 00 |
| Sault Ste. Marie | S. T. Bowker, S. S. Marie | 2,731 88 | 2,278 00 | 1,065 00 | 6,074 88 |
| Sudbury | F. F. Lemieux, Sudbury | 376 75 | 2,505 00 | 2,545 00 | 5,426 75 |
| Montreal River | Albert Skill (*b*), Elk Lake | 108 00 | 6,938 00 | 18,131 25 | 25,177 25 |
| Gowganda (*a*) | H. E. Sheppard, Gowganda | .......... | .......... | .......... | .......... |
| Temiskaming | George T. Smith, Haileybury | 7,125 00 | 19,324 00 | 21,976 56 | 48,425 56 |
| Coleman | T. A. McArthur, Cobalt | 5,679 22 | 9,077 10 | 4,718 00 | 19,474 32 |
| Larder Lake | J. A. Hough, Larder Lake | 1,097 75 | 1,942 75 | 7,059 50 | 10,100 00 |
| Parry Sound | H. F. McQuire, Parry Sound | .......... | 495 00 | 780 00 | 1,275 00 |
| | | 19,933 60 | 45,567 85 | 61,591 66 | 127,093 11 |

(*a*) Established 10 February, 1909.
(*b*) Succeeded T. H. Torrance, 1 April, 1909.

#### Territory Added to Montreal River Division

From the Temagami Forest Reserve Mining Division certain territory was deducted by Order in Council of 21st September, 1908, and added to the Montreal River Mining Division, as follows:

Commencing at the south end of Smooth Water lake, at the source of the east branch of the Montreal river, thence due west astronomically 17 miles, more or less, to the 45th mile post on the boundary between the districts of Nipissing and Sudbury, as surveyed by Ontario Land Surveyor Alexander Niven in 1896, thence due north astronomically along said district boundary 51 miles to the 96th mile post thereon, thence due east astronomically 15 miles, more or less to the end of the portage at the extreme northerly end of the Great Northern Bend on the main branch of the Montreal river leading to Trout lake, thence southeasterly along the west bank of said river with the stream to its junction with the east branch of said river, thence southerly along the east bank of said east branch of said river and along the western limit of the Montreal River Mining Division to the place of beginning.

#### Gowganda Mining Division

The Temagami Forest Reserve was further drawn upon in February, 1909, for the formation of the Gowganda Mining Division, it being deemed expedient to establish the usual local facilities for the recording of the numerous mining claims staked out in the fall and winter of 1908 as a result of the discovery of rich silver ore on the banks of lake Gowganda and elsewhere in that region. The boundaries of the new Division are as follows:

Commencing at a point on the boundary line between the Districts of Nipissing and Sudbury, where the same is intersected by P. L. S. Duncan Sinclair's exploration line run in 1867 near the eighty-sixth mile post on said District boundary; thence south astronomically along said district boundary forty-five miles more or less to a point due west astronomically from the southwest angle of the township of Gamble; thence due east astronomically 19 miles more or less to the southwest angle of the said township of Gamble; thence continuing due east astronomically along the south boundary of said township 6 miles to the southeast angle thereof; thence north astronomically along the east boundary of the townships of Gamble, Brewster, Corkill, Lawson and Chown 30 miles more or less to the northeast angle of the latter; thence west astronomically 6 miles to the southeast angle of the township of Morel; thence north astronomically 6 miles to the northeast angle of the said township; thence west astronomically 9 miles more or less to the centre of the main branch of the Montreal river; thence northeasterly along the middle thread of the said river 10 miles more or less to said P. L. S. Duncan Sinclair's exploration line; thence westerly along said exploration line 16 miles more or less to the place of beginning.

This Division, as will be seen, takes in part of the territory which was formerly included in that of Montreal River. Several of the townships and parts of townships east of the Montreal river belonging to the Temiskaming Division were at the same time transferred to the Montreal River Division, namely, Truax, Smyth, James, Tudhope, Barber, Cane and Auld.

For a time the head office of the Gowganda Division was fixed at Elk Lake, but as soon as the necessary records could be transcribed the office was transferred to Gowganda.

Those portions of the Temagami Forest Reserve not attached to any of the above Mining Divisions constitute a Division, mining claims in which are dealt with by the Department at Toronto. The same course is followed with regard to the Fort Frances Mining Division and in Eastern Ontario, in neither of which districts is there at present sufficient business to warrant the opening of a local office. The receipts for miner's licenses, recording fees and purchase money taken in by the Department direct from applicants do not appear in the above table.

The head office of the Montreal River Division was by Order in Council of 8th July, 1908, removed from Latchford to the town plot of Smyth (Elk Lake P. O.)

This Division was by Order in Council of 19th June, 1908, withdrawn from the operation of section 90 of the Mining Act of Ontario, the effect being that it ceased to be a "Complete Inspection area" under the said Act. Consequently, mining claims taken up therein are no longer as a matter of course required to undergo official inspection for discovery of mineral.

On 18th November, 1908, under authority of subsection 1 of section 39 of the Mining Act of Ontario an Order in Council was passed withdrawing the land under the water of all the lakes in the townships of Haultain and Nicol and in the two townships to the west thereof from the operation of the Mining Act, together with a strip of land one chain in perpendicular width around the shores of the said lakes. The lake beds so withdrawn include those of Gowganda, Miller, and Leroy. Along with the beds of the other lakes in the townships mentioned they are thus placed in the same position as were those portions of the beds of Cobalt and Kerr lakes which realized so considerable an amount for the Provincial treasury.

On 23rd December, 1908, an Order in Council was passed withdrawing a block of about 1,000 acres in the township of Nicol north of lake Gowganda from prospecting, staking out and lease under the Mining Act. The town site of Gowganda was subsequently located in this block, surveyed into lots and offered for sale by the Department in March and April, 1909.

Brief reports covering the business of their offices for the year and indicating the course of prospecting, etc., have been received from the several Recorders, which are summarized, as follows:

#### Kenora

C. W. Belyea, Recorder, Kenora. Miner's licenses issued 60; renewal of ditto 78; claims recorded 73.

Interest in gold mining and prospecting on the increase. Finds of iron ore taken up lately said to be valuable

#### Port Arthur

J. W. Morgan, Recorder, Port Arthur. Miner's licenses issued 340; renewal of ditto 156; certificates of performance of work issued 107; certificates of record 31; claims recorded 370.

More than 100 claims for bog iron ore have been taken up near the C.P.Ry. in the western part of Thunder Bay district, but owing to the marshy nature of the country and the slight demand for the ore, little development work has been done.

Extensive explorations for copper were made in Black Bay peninsula, and 65 claims staked. The indications here are promising. In November it was reported that coal had been discovered near Rossport, on the north shore of Lake Superior, but whether the mineral found is real anthracite coal or not remains to be proved.

#### Sault Ste. Marie

S. T. Bowker, Recorder, Sault Ste. Marie. Miner's licenses issued, including renewals, 300; mining claims recorded, 100.

#### Sudbury

F. F. Lemieux, Recorder, Sudbury. Receipts for miner's licenses $2,505, for recording fees $2,545, for purchase of lands $376.75, total $5,426.75. In 1907 the total was $11,774. The falling off was in part due to the decrease of prospecting around Sturgeon Falls and vicinity.

In the autumn there was some stir caused by reported discoveries of silver near Lake Penage; these were found, however, to have no foundation beyond the occurrence of veins containing calcite and some cobalt bloom. Some gold properties in berth 09 have been turned over to a Montreal syndicate, and it is believed are likely to prove valuable.

#### Montreal River

Thomas H. Torrance was Recorder during the whole of 1908, and until 1st April, 1909, when he resigned and was succeeded by Albert Skill. The head office is at Elk Lake. Miner's licenses issued, 626; renewal ditto, 251; claims recorded, 1,321; total receipts, $25,177.25.

The past year was a very active one in this Division, more particularly the latter part, the greatest amount of activity being shown in the Gowganda and Miller lake districts. Many valuable discoveries were made in the vicinity of the lakes, among them being the Mann, McLaughlin-McIntosh, Boyd-Gordon, Dobie and Reeves, and Milne. The present indications are that this will prove a thriving mining camp in itself.

Considerable development work has been done in James township and at Silver Lake. Some of the companies have installed, or are preparing to instal, machinery; these include the Otisse, Ottise-Curry, Clinton claims, Gavin-Hamilton, Elk Lake Discovery, Mother Lode, Marcell, Devlin, Holden Silver Mines and Moose Horn.

The transferring of the Recorder's office from Latchford to Elk Lake was certainly in the interests of the prospectors and was appreciated by them. A thriving town is gradually growing up here. The service of the Upper Ontario Steamboat company, operating between Latchford and Elk Lake, has been as good as could be expected, taking into consideration the three portages necessary on the trip. The need of a railroad was demonstrated by the quantity of supplies the boats were required to handle and the number of teams (which was over 400) used in the hauling of freight from Charlton after the close of navigation.

Considerable attention has been turned towards the Maple Mountain district, where several new discoveries have been reported and a number of properties have changed hands.

#### Temiskaming

George T. Smith, Haileybury, Recorder. Miner's licenses issued, 944; renewal ditto, 1,654; claims applied for, 1,650; working permits applied for, 41; transfers of mining claims recorded, 926. Total receipts, $48,425.56.

While the receipts are smaller than in 1907, the season was a very active one. A large amount of development work was performed, and a considerable number of properties have changed hands at reasonable prices. Discoveries have been reported from points widely distant, and the indications are that "the end is not yet."

That silver exists in paying quantities in James, Tudhope and South Lorrain seems to have been established, and authenticated reports have come to hand of promising gold discoveries in the townships of Beatty, Cody, Guibord and Munro; and of nickel in Clergue and Dundonald.

Shipments of silver and cobalt ore have been made from South Lorrain, and a large quantity of ore is bagged up there pending better shipping facilities. Several up-to-date mining plants have been installed in this camp, including those on the Keeley, Montrose, Wettlaufer and Murray properties, with others to follow in the near future. An active season's operation is anticipated for 1909.

#### Coleman

T. A. McArthur, Assistant Recorder, Cobalt. Miner's licenses issued, 485; renewal ditto, 780; claims recorded, 270. Total receipts, $19,474.32.

#### Larder Lake

J. A. Hough, Recorder, Larder Lake. Miner's licenses issued, 165; renewal ditto 84; mining claims applied for, 540; certificates performance of work granted, 20; certificates of record, 68; mining receipts, $10,100.

Considerable work was performed throughout the Division, and many new "finds" reported. On the whole, the progress made was not very satisfactory. Larder Lake has undoubtedly received a serious set-back owing to the many impossible wild-cat schemes put on the market, and from the trouble and litigation which has ensued as a natural consequence. Little new capital was put into the camp, and as a result numerous claims with showings which warrant thorough exploration and development, were left idle. Dissatisfaction was also caused by some companies, and also individuals, hiring men and paying no wages when the work was completed.

It is worthy of note that the first gold coins minted in Canada were made of Larder Lake gold.

#### Parry Sound

H. F. McQuire, Recorder, Parry Sound. Receipts from miner's licenses, $495; from recording fees, $780; total, $1,275; claims recorded, 56.

In McConkey township 12 claims were taken up for mica; in McDougall, 2 for feldspar; in Conger, 1 for feldspar; in Laurier, 8 for mica, graphite and copper; in Mowat, 17 for iron; on the Pickerel branch of French river, 3 for gold; in Shawanaga, 1 for mica; in Christie, 1 for gold and silver; in Lount, 2 for copper, gold and silver; in Armour, 4 for mica; in Proudfoot, 3 for mica and feldspar.

The Parry Sound Copper Company discovered on their property in Foley some rich samples of bornite and gray copper, and they have a small force of men working in one of the old shafts at a depth of 100 feet to determine the values. A great want is a conveniently situated smelter to treat the low grade copper ores of the district.

### The Government Diamond Drills

Drill "S" was in charge of Mr. E. K. Roche during the year, and was operated on five different properties. At the Rothschild claim near Cobalt, drilling was begun in the latter part of 1907 and continued until February, when the drill was moved to the Shamrock property. Here it was operated during March, April and May. At the Little Nipissing mine the drill was busy during June, July and August, after which it was removed to Peterson lake, where it remained until the latter part of October. In November it was shipped from the Cobalt district to the outskirts of the town of Madoc, Hastings county, where, however, it was made use of for a few days only.

On the Rothschild claim six holes were drilled, 304, 90, 60, 86, 94 and 88 feet respectively. Judging from the description of the cores given by Mr. Roche, in charge of the drill, Keewatin was encountered at 104 feet in hole No. 1. The cores of the remaining holes are all described as diabase. Drilling was begun November 2nd, 1907, and completed February 29th, 1908. The gross cost of the operations was $3,938.10 or $5.45 per foot of drilling. Deducting 35 per cent., which is borne by the Department, the net cost to the company was $2,559.76 or $3.54 per foot.

On the Shamrock property drilling was started on March 28th and ended on May 26th. One hole was put down to a depth of 245 feet. Mr. Roche notes that Keewatin rocks were encountered at about 122 feet. The gross cost of operations was $2,481.98 or $10.13 per foot of drilling. The net cost to the company was $1,613.29 or $6.58 per foot.

At the Little Nipissing mine one hole was drilled a total depth of 499 feet. From the descriptions given by Mr. Roche it would appear that the first 160 feet of core were Lower Huronian, the remainder Keewatin. The gross cost was $1,474.78 or at the rate of $2.95 per foot. Of this amount the Government pays 35 per cent., making the cost to the company $958.60 or at the rate of $1.92 per foot. The drill began operations June 16th and ended August 10th.

A hole 373 feet was drilled in Peterson lake. Drilling operations were carried on between August 19th and October 20th. The first 48 feet consisted of sand, gravel, boulders, etc. According to Mr. Roche, the remaining 325 feet consisted of diabase, in which occasional calcite stringers were noted. The gross cost was $1,992.08 or $5.34 per foot. Deducting 35 per cent. which is borne by the Department, the net cost to the company was $1,294.58 or $3.47 per foot.

On lot one in the fourth concession of the township of Madoc, Hastings county, a hole 32 feet was drilled. The first 29 feet of core showed limestone, while the last 3 feet consisted of a hard "trap." Fluorspar was being prospected for. The drilling operations were carried on between November 18th and 21st inclusive. The gross cost was $484.92, including cost of transportation from Cobalt, which ran the price per foot up on so small a job.

Drill "C" was in charge of J. A. MacVicar. It was in operation on three properties during the year. In April and May it was drilling in Conmee township, Thunder Bay district, from which it was transported to Shedden township, Algoma district, where it was in use during part of August. In October and November the drill was operated not far from Atikokan for the purpose of prospecting certain iron ore bodies.

In Conmee township, Thunder Bay district, two holes were drilled between April 10th and May 13th. No. 1, on location T.B. 196, reached a depth of 250.5 feet. Mr. MacVicar reports the drill core to be greenstone and greenstone schist. No. 2, on location T.B. 3, reached a depth of 20.7 feet. The core was magnetite and greenstone. The gross cost of the operations was $3,930.37 or $14.49 per foot. Deducting the 35 per cent. borne by the Department the net cost was $2,554.77 or $9.42 per foot.

In the township of Shedden, Algoma district, two holes were drilled. Their location is about seven miles from Cutler station on the C. P. Railway. Hole No. 1, was drilled to a depth of 83 feet, and according to Mr. MacVicar's report, the core showed quartz and granite. No. 2 was 36 feet, and the core was reported to consist of quartz with some chalcopyrite. Drilling was begun August 3rd and finished on August 15th. Considerable difficulty was experienced in transporting the drilling outfit from the railway station to the property. The gross cost was $2,319.91 or $19.49 per foot. The net cost was $1,507.95 or $12.66 per foot.

Two holes were drilled on claim known as G. 716 which is located about 5¾ miles from Atikokan. Drilling began on October 13th and ended November 30th. The first hole was abandoned on reaching a depth of 18 feet owing to its caving in. The second hole was drilled 168 feet at an angle of 72 degrees. Mr. MacVicar reports the core to consist of banded chert, hematite and schistose material. A body of hematite and quartz was drilled through between 92 and 109 feet. The gross cost was $2,319.91 or $11.64 per foot. The net cost was $1,408.45 or $7.57 per foot.

## Provincial Assay Office

Mr. N. L. Turner, Provincial Assayer, makes the following report:—

The Provincial Assay Office was established in July 1898 by the Ontario Government, as an aid to the mineral development of the Province. The Office has rendered many services to the public, as is shown by the large number of assays and analyses made. The rates are sufficiently low to allow prospectors and others to have their finds examined at very moderate cost. The office is well fitted with assay and analytical apparatus for the testing of the various ores and minerals which are distributed so widely throughout Ontario.

The greater part of the samples submitted for examination during the past year came from the northern part of the Province. Prospecting has not been so energetic this year as last, the tightness of money no doubt being felt in this as in other directions. Samples of cobalt-bearing ore were received from districts at a considerable distance from Cobalt, and there is no doubt that what has been done at Cobalt is only a beginning of the work. The new discovery at Gowganda during the latter part of the year will greatly stimulate the search for silver-bearing minerals. At present it would appear that nearly all prospectors are looking for silver, to the exclusion of the other minerals of the Province.

A very noticeable feature of the year was the dropping off in the number of copper samples received: this is probably due to the drop in price of copper.

A number of new discoveries were made in older districts, as for example the discovery of a new gold field in the Rainy River district, which gives promise of being very rich. There have also been some very good gold finds in the country north of the Cobalt area, such as in Munro and Guibord townships.

Iron ore samples of excellent grade were received from different parts of the Province. One very noticeable feature of the iron samples is that while the majority are very low in sulphur and phosphorus contents, they are also low in iron. Some process of concentration of these ores would make them valuable. Ontario appears to have a great supply of low grade ores and when the high grade deposits have been exhausted, as they will be before very long, these will be especially valuable on account of their purity.

The office has numerous times advised the search for non-metallic minerals, such as fluorite, fire-clay, etc. Numerous inquiries regarding these deposits have been received. As far as is known fire-clay has not been produced in Ontario, present imports being from the United States or England.

During the year 967 samples were assayed and analyzed in whole or part, giving the percentage of the constituents, and 100 samples (exclusive of those brought to the office, which are identified without charge) were reported on as to probable commercial value. Fees to the amount of $741.85 were remitted to the Bureau of Mines. The value of the work performed for the Bureau was $878.45, making a total of $1,620.30 for the year.

### Work for Bureau of Mines

1. Checking the sampling of O'Brien ore.
2. Checking the sampling of Crown Reserve ore.
3. Checking the sampling of Provincial Mine ore.
4. Assaying of check samples and totalling silver values of cars of ore.
5. Analyses for report on Iron Ores of Ontario.
6. Analyses of rock samples from the Cobalt silver area and other districts.
7. Identification of miscellaneous samples.

### Work for the Public

1. Issuing reports, consisting of assays, analyses, and identifications of samples submitted for test.

2. Supplying information to owners of mineral lands as to probable markets for their ores and also as to prospective buyers.

### Assays and Analyses Made

The following list of determinations will show the laboratory work for the year:

| | Assays for Bureau. | Assays for Public. | Total. |
|---|---|---|---|
| Gold | 115 | 342 | 457 |
| Silver | 336 | 245 | 581 |
| Copper | 3 | 70 | 73 |
| Nickel | 11 | 17 | 28 |
| Cobalt | 76 | 3 | 79 |
| Manganese | 1 | 4 | 5 |
| Zinc | .... | 4 | 4 |
| Platinum | 2 | 5 | 7 |
| Lead | .... | 9 | 9 |
| Arsenic | 22 | 3 | 25 |
| Antimony | .... | 1 | 1 |
| Gold by Amalgamation | .... | 3 | 3 |
| Mercury | 1 | .... | 1 |
| Chromium | .... | 1 | 1 |
| Total | 567 | 707 | 1,274 |

| | Analyses for Bureau. | Analyses for Public. | Total. |
|---|---|---|---|
| Metallic Iron | 74 | 65 | 139 |
| Alumina | 6 | 60 | 66 |
| Ferric oxide | 6 | 10 | 16 |
| Silica | 41 | 10 | 51 |
| Sulphur | 47 | 35 | 82 |
| Phosphorus | 37 | 25 | 62 |
| Titanium | 21 | 15 | 36 |
| Silicon | .... | 1 | 1 |
| Lime | 8 | 11 | 19 |
| Magnesia | 8 | 10 | 18 |
| Insoluble | 38 | 3 | 41 |
| Alkalies | 4 | 2 | 6 |
| Loss on ignition | 4 | 4 | 8 |
| Magnesium Carbonate | 1 | .... | 1 |
| Calcium Carbonate | 1 | .... | 1 |
| Moisture | 1 | 3 | 4 |
| Sulphur trioxide | 1 | .... | 1 |
| Chlorine | 1 | .... | 1 |
| Carbon di oxide | .... | 2 | 2 |
| Volatile Combustibles | .... | 1 | 1 |
| Fixed Carbon | .... | 1 | 1 |
| Ash | .... | 1 | 1 |
| Total | 299 | 259 | 558 |

### Methods of Analysis

The following methods of analysis are in use:—

Gold,—The ordinary pot assay on low grade ores using ½ A.T. samples. The samples are ground very fine for gold so as to make the result accurate for small amounts.

Silver,—The ordinary pot assay is used on low-grade ores. On high-grade silver ores, such as those from Cobalt, a scorification method is in use. This work is done very carefully, so as to obtain the most accurate results. 1-10 A.T. is used as a sample for the fines and 1-20 A.T. for the scales. It is very likely that in the near future an electrolytic method will be substituted. Research along these lines is now being carried on at the office.

Nickel and cobalt,—At present the ordinary method with a nitrite separation is being used for these two metals. A new method is being worked out for this also, and will be substituted for the old one in the early part of 1909.

Copper,—The electrolytic method is used for copper. A very rapid method has been evolved using a rotating anode by means of which the copper in an ordinary sample can be plated out in five minutes.

Other metals are estimated by standard methods.

The office is now equipped with a first-class electroplating outfit, and in the future many of the metals will be estimated by an electrolytic method. The use of a rotating anode and special forms of cathodes makes these methods very accurate and also very rapid.

#### Notes

In sending in samples it is desirable to have them not more than three pounds in weight. All samples are sampled down when necessary and ground to 100-mesh. Wet samples are dried at 100 degrees C. and the analysis reported at that temperature. Circulars of rates, and mailing envelopes, are supplied to all those desiring to send in samples for examination. It is desirable that all fees should be forwarded with the samples, so that there may be no delay in issuing reports.

Samples brought to the office are examined free of charge, except where a quantitative examination is required.

During the year two assistants were employed, Mr. T. E. Rothwell looking after most of the outside work at Deloro and Copper Cliff, and Mr. H. C. Barlow the fire assaying.

---

## Mining Accidents

Forty-seven men were killed by accident in and about the mines of Ontario in 1908, and fourteen seriously and twenty-six slightly injured—a distressing record. Of the fatalities eight took place above ground, and thirty-nine below ground.

The accidents of the year are analyzed as to their causes and fully dealt with below by Mr. E. T. Corkill, Inspector of Mines, and his thoughtful treatment of the subject should be taken to heart by mine owners, mine managers, and miners, each and all of whom in their respective spheres contribute to the causes leading up to so disastrous a waste of human life, and by whose co-operation only can such waste be reduced to a minimum. Perhaps it is too much to expect its entire elimination.

Details of the various casualties are given, and these are followed by Mr. Corkill's paper.

#### Canadian Copper Company

Near the Crean Hill mine January 25th at noon, R. Therien, a brakeman, fell from a train of empty ore cars. A leg and foot were badly crushed by the wheels and he died the following day.

The coroner's jury returned the following verdict: "That Rosario Therien, brakeman, fell from train by accident, while moving toward Crean Hill, breaking his leg, but death was due to loss of blood from artery in fractured leg, according to the doctor's evidence."

At Crean Hill on February 28th, at 4.45 a.m., Augusti Miettinen, drill-helper, (known on the pay roll of the Canadian Copper Company as Matt Hill) was instantly killed by riding on the skip. The deceased got on the skip at the third level, but seems to have hung over the side, because at the second level his body was practically cut in two. There is very little clearance at the different levels between the skip and the timbers.

The coroner's jury returned the following verdict:

"That the death of Augusti Miettinen was accidental and due to the deceased disobeying the order of the Canadian Copper Company, which forbids employees to ride on skips."

At Copper Cliff on March 23rd at 7 a.m., Jno Kangas (John Gandos) matte loader, was run over and instantly killed by a slag train. An engine was pushing two slag pots. According to the statement of the engineer, the bell was ringing from the time the train left the smelter until the deceased was struck. The engineer was signalled to stop, and Kangas was shouted at by a man who saw the danger the deceased was in. From the evidence it appears the latter was in an absent frame of mind. He was walking along the track on his way to work and the engineer does not appear to have seen him. The coroner's jury brought in the following verdict: "Our verdict is that John Kangas met his death by accident."

At the Creighton mine on April 10th in the afternoon John Heittala, machine-man, was struck in the chest by a piece of rock, causing him to fall about fifty feet. He died the following day at the Copper Cliff hospital. The deceased had been running a drill in the southwest corner of the open stope for five months. At the time of the accident he was working about 20 feet from the surface of the pit, and while loading holes a piece of ore from the surface started rolling and struck him in the chest. He was knocked backwards, falling 10 feet to the next bench, and then rolling a further distance of 40 feet to the bottom of the stope. Drill runners are always expected to scale the ground after blasting, and for this purpose they are allowed extra time.

The coroner's jury returned the following verdict:

"John Heittala, a miner at the Creighton mine, came to his death by injuries received from a piece of rock which became loosened from its place in the wall of the mine, striking his chest and causing him to fall a distance of about 10 feet and rolling a further distance of 40 feet down the mine at Creighton."

At the Crean Hill mine on May 29th August Sapola, trammer, was mucking at number four level, when an explosion occurred causing serious injuries to his eyes, nose and lips. It seems that the explosion was caused by his pick striking a piece of gelignite that had been lying in the muck for a long time.

At the Creighton mine, on May 30th, Commoso Davide, trammer, was mucking in the drift on the second level, when a piece of ore about the size of a brick fell four feet, striking him on the head, inflicting a small scalp wound and causing paralysis in one leg and arm.

At the Creighton mine June 19th Andruch Bijko, trammer, was knocked down by a large piece of rock, and his death ensued the following day. The wall had been scaled previous to the accident. The coroner's jury returned the following verdict: "We find that the death of the said Andruch Bijko was accidental, being caused by a mass of rock weighing about 800 pounds becoming detached from wall during course of operations, falling some 10 feet to muck pile, then rolling down 15 feet more and catching deceased on legs throwing him down on his back on the rocky floor of the mine with such force as to cause death from injury to head."

At the Creighton mine on June 18th Dimitru Lakatus received injuries about the head and shoulders from explosion of a small piece of dynamite in the muck. Some pieces of ore were being rolled down the stope, one of them striking the dynamite which was near the point where the injured man was standing. He lost the sight of one eye.

At the Creighton rock-house on July 16th Tom Dominico was crushed to death by being caught between a moving car and a supporting timber of the rock-house. The coroner's jury returned the following verdict: "We the jury find that Tom Dominico came to his death by being accidentally crushed between a car and a post. We also believe that death was caused by his own carelessness."

At the Crean Hill mine on August 10th, at 10 a.m., Megali Gordi was run over by an ore-car and instantly killed. In order to load the rock and ore into the cars that pass under the rock-house, the tracks are laid at a grade that will permit the cars to run by loosening the brakes. The deceased was on a 5-ton jimmy car, which had been loaded with rock. He was standing on the front of the car loosening the brake, so that the car would move. He had in his hand a stick or rod by which he was manipulating the brake, when his bar slipped and he fell to the ground in front of the car, and before he could get out of the way, it had run over him. The coroner's jury returned the following verdict: "That Megali Gordi came to his death by accidentally slipping under a car while tightening the brake, three wheels passing over his body."

At the Naughton quartz quarry on August 13th about 10 p.m., Oscar Lanthanon, machine man, was struck by a rock causing him to fall from his machine. He died as a result the next day. The walls of the pit immediately over the point where the deceased was working, are said by John Lawson, general superintendent, to be perfectly smooth, and that the piece of rock that fell was not loose ground that came away from the walls, as the walls themselves are in first-class condition, and a different character of rock from the piece that fell. The latter had apparently become lodged on a small shelf. The coroner's jury returned the following verdict: "That the deceased came to his death by falling from his machine in the quartz mine at Naughton, and causing a fracture of the base of the skull by striking on the rocks."

At the Crean Hill mine on September 8th at about 8.15 p.m., Mike Duisdank, mucker, was struck by a rock on the head and died as a result on September 12th, in the Copper Cliff hospital. Deceased was working on the first level of the mine near the centre of the face of the open cut engaged in loading a car along with several other men. One of them, working near the deceased, was struck on the shoulder with some small pieces of rock and ran back from the face. When the men returned they found Duisdank lying face downward at the place where he had been working. The stope on this level is about 90 feet in height and is being carried back as an open-cut. Some of the machine men were working on the face of the stope and the piece of rock which fell must either have been loosened by the machine men or had fallen from the face, not having been properly scaled. The coroner's jury returned the following verdict: "That the deceased came to his death by accident while at work in the Crean Hill mine."

At the Creighton mine September 23rd, in the morning, Jamb Cottock, machineman, was killed while scaling. Deceased was working in a raise near No. 2 shaft, and after blasting he and his helper went down to scale about 30 feet from the surface. They had just commenced scaling when a loose piece of rock or ore fell from above, striking Cottock and knocking him off the bench. He fell to the bottom of the raise on a pile of muck, alighting on his head, and fracturing his skull. He died almost instantly.

The jury brought in the following verdict: "We the jury find that the deceased, Jamb Cottock, came to his death by falling from a bench on which he was scaling, the fall being caused by a rock falling from above him and hitting him on the head. We cannot see that any person was to blame, but find that death was purely accidental."

### Helen Iron Mine

On April 17th at 5.15 a.m. Johan Maki fell 15 feet down a raise owing to the breaking of staging. His ankle was sprained.

On April 10th at 11.20 p.m. John Calligaro, blacksmith, had his right eye seriously injured by the breaking of a hammer in the blacksmith shop.

On May 1st at 11.45 a.m. Matti Kinnari, miner, was struck by a descending cage, resulting in dislocation of the shoulder joint and injury to the lids of both his eyes.

On June 25th at 3 p.m. Wasyl Suilga, trammer, had part of the middle finger of his left hand crushed while dumping ore.

On July 5th at 4 a.m. Iwan Prodaniuk, trammer, was struck by a large piece of ore; falling down the stope, he bruised his leg.

On July 14th at 9 p.m. Jan Straivinski had two fingers crushed by being caught between two cars.

On July 28th at 1.30 a.m. J. L. Svanson, chute tender, had his thigh crushed in the region of the hip joint. He was trying to stop an ore car and was caught between it and the one ahead.

On August 27th at 10 p.m. Wm. Nyholm was tightening a nut on machine when the wrench slipped and he fell 15 feet down the stope, spraining his left ankle and bruising his right knee.

On September 7th at 10 p.m. J. Kakka, miner, had the middle finger of his left hand crushed by a piece of falling ore.

On September 11th at 10 a.m. John De Diana, miner, had the muscles of the back strained by lifting a large piece of ore into the bucket.

On October 13th at 4 a.m. W. Fedake, trammer, had his right leg bruised by a piece of falling ore.

On October 13th at 4 a.m. John Kielec, trammer, had his head cut, shoulder bruised and left lung injured by a piece of falling ore.

On October 13th at 4 a.m. C. Agnese, trammer, had back of right hand cut by a piece of falling ore.

On October 17th at 4 a.m. John Jachec, trammer, had his right arm bruised by a piece of falling ore.

On October 31st at 4 p.m. P. Butorac, trammer, was bruised in the pelvic region by being caught between two cars.

On November 5th at 11 a.m. Pete Czkucz had the little finger of his left hand crushed by piece of falling ore.

On November 13th at 4 p.m. Victor Kumpu, miner, had his right ankle bruised, caused by the tripod slipping.

On November 19th at 2.30 p.m. Sali Kuja, trammer, had his right leg bruised by a piece of falling ore.

On December 11th at 11.30 a.m. Wm. Russell, trammer, had the middle finger of the right hand crushed when lifting a car on to the track

#### Mond Nickel Company

At Victoria Mines, on July 8th, at 10.30 a.m., Mike Kasmark, Makxym Tryjomak and Nicholas Belinski, muckers, were instantly crushed to death. The accident occurred at the entrance to the east stope, sixth level. Six men were mucking from this level on the day of the accident. Four men were shovelling at the time the rock fell and two had just come back from the shaft with an empty car and were waiting for this car to be loaded, thus standing back of the other men. Without warning of any kind, except a little dirt falling, a mass of rock on the south side of the wall of the stope fell over, crushing three of the men under it. The two muckers waiting for the car claimed to have seen some pieces falling and shouted to the others, but were too late to save them. The mass of rock which fell was about 10 feet wide, 10½ feet high and 2 feet thick at the top and 1½ feet at the bottom, and would weigh approximately 4 tons. The foreman, Wm. McKerrow, stated that he had been standing over this piece for half an hour the morning of the accident and had seen no indication of any crack in it. Work had been going on at times in the stope for three years. On account of the large size of the rock, it was hard to detect that it was loose by sounding. The stope had been scaled on the 5th, but nothing was done at this piece as it was not thought to be loose, no crack having been seen in it. The piece had remained standing for two to three years, but constant blasting in the stope must have gradually loosened it.

The coroner's jury returned the following verdict: "We the jury find that Mike Kasmark, Makxym Tryjomak and Nicholas Belinski came to their death in Victoria mine No. 1 on July 8th at about 11 a.m. by being crushed under falling ground. We believe that their death was purely accidental."

At Victoria Mines on December 18th at 5.40 p.m. Steve Kat was instantly killed while getting into a cage. A group of machine men on the seventh level, waiting for the cage at the end of the shift, stopped a cage already full and being hoisted from a lower level. The engineer stopped, but almost at once received the starting signal and accordingly hoisted. Three men apparently tried to rush into the cage rather than wait until it was returned in the regular way to their level. Kat, a machine runner, not being securely inside the bale, was struck on the hips by the station cap and killed instantly by dislocation of his neck, the jar throwing his head backward, over the bale. The coroner's jury returned the following verdict: "We find that the late Steve Kat came to his death by being caught between the cage and the timber above the seventh level. The cage started before he was properly on. We find the engineer got the proper signals to hoist, but we find it impossible to tell who gave the signal."

At Victoria Mines on November 20th at about 9.40 a.m. Alex. Durboyk, mucker, was struck by falling ore, causing a fracture of the skull. Death resulted on the 24th

of the same month. The deceased was working on the fifth level. The mine superintendent asserts that the place from which the ore fell had been scaled the day before the accident.

The coroner's jury returned the following verdict: "We the jury find that Alex. Durboyk came to his death as the result of being accidentally struck on the head by a piece of falling ground while at work in the fifth level of the Mond mine on November 20th."

#### Beaver Consolidated Mines

On November 16th at 1.05 p.m., Andrew Osman and John Aha fell from a bucket and were instantly killed. The two men got on the bucket at No. 1 shaft and signalled to the engineer to be lowered. It appears that the accident was caused by the crosshead sticking some place in the shaft. After the bucket had been lowered some distance below where the crosshead stuck it became loosened, falling to the bucket, and either struck the men knocking them out of the bucket, jarred them out, or upset the bucket. The falling of the cross-head also would cause the breaking of the two strands in the cable which were found broken after the accident. The accident, however, was not caused by there being a defective cable, as any cable would be liable to break under the shock of the crosshead falling. The cable, however, stood the strain, as three strands were intact. The hoistman was also free from blame in regard to the accident. The company had not provided a ladderway from the first to the second level, thereby practically compelling their employees to break the law by riding the bucket in going down to their work and in coming out. This neglect was not due to ignorance of the law on the part of the management. The coroner's jury returned the following verdict: "That the said Andrew Osman and John Aha came to their death November 16th in the shaft of the Beaver Consolidated mine, by injuries received from a fall from the bucket in the shaft of the aforesaid mine; and that the accident was caused by direct negligence on the part of the management, insomuch as they allowed the men to go up and down the shaft in the bucket instead of proper ladders, which should have been supplied and used. And that the attention of the superintendent was called to the fact of the cable being defective, and yet he allowed the said cable to be used. We wish to recommend that the attention of the Government be called to the fact that young men of seventeen years of age are being employed in running the hoist."

Mr. E. T. Corkill, Inspector of Mines, submits that these last two circumstances had nothing to do with the accident. A boy seventeen years old is allowed by the Act to run the hoist, provided men are not being hoisted or lowered, and in the case of this or any other mine men are by law forbidden to ride in the bucket.

The company and superintendent were prosecuted by the Department for violation of the Mining Act, and were fined the maximum amount provided by the Act.

#### The Buffalo Mine

On December 17th about 3 p.m. the No. 3 boiler blew up scalding Emil Lavergne so seriously that he died about 12 hours later. The boiler was inspected by Mr. Roger Fishleigh, boiler inspector for the Boiler Inspection and Insurance company, three weeks prior to the accident and was reported to be in first class condition and good for a working load of 135 lb. per square inch. Mr. Fishleigh inspected the boiler again after the accident, and at the coroner's inquest swore that there were not more than 24 inches of water on the crown shaft at the time of the explosion; he further stated that the explosion was caused by the water having been allowed to go down in the boiler at least two feet below its required level. The fireman in charge swore that the water in the glass was within two or three inches of the top. This might have been owing to the pipes being stopped by dirt. The fireman, however, should have tried the water cocks to show the level of the water. He was out of the boiler house at the time of the explosion, but he swore that he had not been away more than two minutes and that

the steam pressure when he left registered 90 lb. No one was in the boiler house at the time of the accident but the deceased. It seems reasonably certain that the explosion occurred through the negligence of the fireman in allowing the water to get so low in the boiler that the crown sheet was heated red hot, and the pressure of the steam against the red hot plate caused it to draw out until it reached the limit of its elongation, when it broke.

The coroner's jury returned the following verdict: "That Emil Lavergne, while in the boiler house of the Buffalo mine, received in and upon his head, face, mouth and throat and other exposed parts of his body, certain mortal burns and scalds due to the bursting and exploding of boiler No. 3, of which said mortal burns and scalds he died, and we consider that the cause of the explosion of the said boiler, from the evidence, does not appear, and so the jurors aforesaid, upon their oath aforesaid, do say that the said Emil Lavergne, in manner and by the means aforesaid, accidentally, casually and by misfortune came to his death and not otherwise."

An action was entered by the Department against the fireman, but as it was considered the evidence was not sufficiently strong to convict, it was allowed to drop.

#### City of Cobalt Mining Company

On June 5th at 11.50 p.m. R. R. Hipkens was using the pick in cleaning up muck. He struck a piece of dynamite that had missed fire, resulting in an explosion that caused serious injury to the head. He died from the effects on June 15th. The deceased was working on the 137-foot level, in the south drift 64 feet from the main shaft. Blasting had been done here on the 6th of May.

#### Columbus Cobalt Silver Company

On December 23rd at 2 a.m. Wm. Hamilton, Fred McNulty and Ed. Martin were killed by falling from a bucket. On the night of the accident these men and one Henry Gratin were at work in the shaft. A round of holes had been drilled and was fired at 1 a.m. The men had eaten their lunch and started to go down the shaft at 2 a.m. The deceased got on the bucket while H. Gratin remained on the surface giving them a light after they got down below the level of the collar of the shaft. When the men had got to a depth of about 65 feet the engineer felt a sudden jerk on the cable; this was followed by a flopping of the cable so violent that it was jarred off the sheave. Wm. Shevell, superintendent, was summoned and he with the other men went down and found that the deceased had fallen from the bucket to the bottom of the shaft a distance of about 180 feet.

Inspector Corkill's examination seemed to show that the accident resulted from the cross-head being hung up in some way on the guides, probably by ice, and then, suddenly becoming loosened, descended and knocked the men off the bucket. The coroner's jury returned the following verdict: "That F. McNulty, Wm. Hamilton and Ed. Martin came to their death at the Columbus mine by being thrown from the bucket between the surface and the 150-foot level, falling to the bottom of the shaft, and that their death was caused by the cross-head being held up and suddenly dropping and knocking the men off the bucket. We, the jury, strongly recommend that the Mining Act of Ontario be rigidly enforced in the matter of mining operations. We find from evidence given that the Mining Act is being seriously disregarded."

Inspector Corkill had inspected this mine on December 3rd and gave the following instructions:—(1) Have powder moved to old cross-cut. (2) Have the ladder put in good condition and the shaft and ladderway partitioned off to the bottom of the shaft. (3) Forbid riding on the bucket.

#### Crown Reserve Mining Company

On December 22nd, G. Paradis, carpenter, was injured by the explosion of a detonator which he picked into while engaged in tearing down an old ore-house.

#### Drummond Mines

At the Drummond mine on February 17th, H. Evans and W. E. Englehutt were dropped 45 feet while in a bucket in No. 4 shaft. There must have been sufficient friction between the brake band and the drum of the hoist to break the fall, or the men would have been killed. Only slight injuries were sustained.

#### French-Greensmith Prospect

This new claim is situated in the northwest corner of lot five, concession five, in the township of Barber. A shaft about 40 feet had been sunk. On July 31st, James H. McDonald, Edward Foley and Malcolm Gillies were working in this shaft and were suffocated by gas. The bodies were found by A. A. French. It is supposed that Gillies went down the shaft and was overcome by gas, and that McDonald and Foley went down to assist him, as they had put his legs partly into the bucket, when they were also overcome and lost their own lives. The coroner's jury returned the following verdict: "That the said James H. McDonald, Edward Foley and Malcolm Gillies came to their death on the thirty-first day of July in the year 1908 by being accidentally suffocated by gas in the shaft of a mine known as the French-Greensmith mine, and that no blame can be attached to anyone."

#### Mining Claim No. 223

On September 21st at 9.30 p.m. on claim No. 223, Hubert lake, township of Farr, A. Chabot, foreman, and Chas. Spute received serious injuries from an explosion of gelignite. The men were working in a shaft 69 feet deep. A hole had been missed the previous shift but had been pointed out to the injured men. The latter had almost completed mucking out the shaft when one of their picks accidentally struck the missed hole. Chas Spute has his right arm fractured, while A. Chabot lost the sight of both eyes and sustained a compound fracture of the right leg.

#### Grey's Siding Development Company

This copper prospect is situated about three miles from Grey's siding, T. & N. O. railway. On October 6th, R. Blair, carpenter, cut his foot with an axe.

#### Keeley Mine

On August 20th, early in the morning, F. Nelson was seriously and Matti Hytte fatally injured. During the temporary absence of the hoistman, two miners after ascending the shaft by means of the ladder, attempted to hoist Nelson and Hytte in the bucket. Through ignorance of the use of the lever the latter were dropped down the shaft to the 65-foot level. Matti Hytte died as a result of the injuries.

#### Kerr Lake Mining Company

On September 12th, at 1.30 a.m., F. A. Whalen, machine-man, was killed, and T. Rushworth, helper, was injured by an explosion of dynamite. The men were working in a cross-cut from No. 7 adit and the machine-man had completed loading a round of eight holes. After the first fuse was lighted a mucker who was working here, left the drift and went to the mouth of No. 7 adit, a distance of 250 feet, and waited there for the other men. He had been away from the heading two to three minutes when he heard a report. A little later the helper came out of the adit injured and reported the accident. It is thought that the machine-man and his helper had trouble in lighting some of the holes and remained too long, and the first hole lighted exploded

before they got away. Six-foot fuses are used by the company which would burn approximately 2 minutes and 50 seconds, an adequate length of time for the men to get to a safe place.

The coroner's jury returned the following verdict: "That the said F. A. Whalen came to his death on Saturday morning September 12th, in a tunnel at the first level of the Kerr Lake mine by accident from an explosion of dynamite, the cause of which is unknown."

#### La Rose Mine

On May 4th, between 11.30 a.m. and 12 o'clock noon, Napoleon Leonard and Stefan Saravana, helper and machine-man respectively, were killed by the premature discharge of a blast. The men were working in a drift at the 150-foot level. Fourteen holes had been drilled in the heading. It was the custom sometimes to fire the holes in two rounds and sometimes in one. In this case the former practice was followed, and in the first round eleven holes at least and probably more had been fired, as three of the holes left unbroken showed that they had been blasted and reloaded. All the holes left from the first round had been reloaded for firing in the second round. Napoleon Leonard was seen after he and his partner had fired the first round. The deceased stated that they had not had time to spit all the holes, one having been left unlighted. The length of fuse used was from six to seven feet, which would burn approximately three to three and a half minutes. Twenty-five feet from the heading where the accident occurred was a cross-cut where the men would have been safe from any material injury. The machine-man was about eight feet from the heading and the helper about eight feet behind him. The accident could not have happened while loading the holes, as the loading stick, etc., had been taken back to the cross-cut and put away. It seems likely that the fuse was ignited by a candle snuff falling from the candlestick probably hanging above it on the wall, and that the men were struck while walking into the drift, after having stored away their tools.

The coroner's jury returned the following verdict: "That Napoleon Leonard and Stefan Saravana came to their death on Monday May 4th in a drift at the 150-foot level of the La Rose mine, by premature discharge of a blast, the cause of said premature discharge unknown. We would recommend that all mining companies avoid having two men working together who do not understand the same language."

#### Nancy-Helen Mine

On May 7th, Robert Lavine, machine helper, fell from the 100-foot level a distance of 50 feet, causing a fracture of the skull and resulting in his death at 8 a.m. the following day. The deceased had left the drift with an empty pail and his candle for the purpose of getting water for the drill. A bucket of water had been placed south of the shaft opening for this purpose. No more was seen or heard of the deceased until he fell down the shaft. There was plenty of room to pass around the shaft opening. When there was no mucking going on in the shaft, the doors covering the shaft opening on the 100-foot level were kept closed. When the doors were open there was no guard rail around the opening as required by the Mines Act.

Inspector Corkill visited the mine in February but no work was then being done below the 100-foot level. Since that time the shaft had been sunk 50 feet below the level. In all other respects the 100-foot level was in accordance with the Mining Act.

The coroner's jury returned the following verdict: "That the said Robert Lavine came to his death through injuries received on May 7th at the Nancy-Helen mine at Cobalt, by falling down the shaft through negligence of the company in not having guard rails around the shaft, as required by the Mines Act."

### Nipissing Mining Company

At the Nipissing mines on January 29th at 2 p.m E. Belanger was engaged in picking into some rocks for the purpose of making a place to set a foundation post. He struck what appears to have been a detonator which exploded, filling his face with pieces of rock.

On February 11th about 1.15 p.m. Thomas Roi (or King), machine-man, was working in the raise from the east drift on the Kendall vein. On the previous day six holes had been fired and six reports counted. One of the holes had been cut off and some gelignite still remained in it. The timberman drew the attention of King to this. The latter removed one of the sticks giving it to the timberman. In scaling the rock from the roof the remaining gelignite exploded, destroying King's right eye and inflicting other injuries.

On March 25th at 11.30 a.m. Panfilo Chiocchio, machine-man, was instantly killed by an explosion of dynamite. The deceased had drilled three holes in an open cut at vein No. 86, and loaded them with eleven sticks of dynamite. Bosati Sebastino was in the open cut below the holes that had been drilled, mucking while the holes were being loaded. After they were loaded, he came up out of the cut and stood at the top ready to help deceased pull up the short ladder. He saw deceased light the fuse and then heard an explosion. This might have been caused either by a quick burning fuse, or because of not having any tamping in the hole, the fuse thereby spitting into the hole and exploding the dynamite. The shift boss said he had never known deceased to load a hole without tamping it. It is impossible to arrive at a conclusion as to which was the real cause. The number of accidents from quick burning fuse is very small.

The coroner's jury returned the following verdict: "That the said Panfilo Chiocchio came to his death about 11.30 on Wednesday morning the twenty-fifth day of March, accidentally, in a cut at No. 86 shaft of the Nipissing mine by injuries caused by a premature explosion of dynamite in said mine. And we further find that proper precautions have not been used by the management of the Nipissing to examine the competency of men as shift bosses, or men handling dynamite, as the shift boss, Dominick Nascioli, had never worked in a mine prior to his employment at the Nipissing mine, which dates back a few months only."

Inspector Corkill while investigating the accident found that Dominick Nascioli had been employed at the Nipissing mine since June 1st, 1907, and had been shift boss since November, 1907. Prior to this time he had charge of men on excavation work in Nova Scotia. He had been shift boss for six years on work where explosives were used. It is quite true he had never worked in a mine prior to his being employed in the Nipissing, but, as stated above, he had had charge of work six years where explosives were being used.

On April 1st at about 11 a.m. P. J. Leanny, M. E. Dougherty and A. Dubreuil, ore sorters, were engaged in removing muck from a tramway. Leanny was handling a pick which struck some explosive in the muck, resulting in the loss of his left eye, and in other injuries. The two men with him were not seriously hurt.

On September 28th at about 7.30 p.m. Emil Mikkalo, miner, was suffocated by gas. Two other men, Angus Soari and Otto Ramner, who were with him, recovered. The accident happened in No. 1 west raise on the 140-foot level of the Kendall vein. The raise had been put up about 60 feet from the level. The day shift had fired a round of holes in the raise. The deceased on going on shift had connected the air hose with the air pipe and started up the raise, neglecting to turn on any air. He went up about 45 feet and then apparently was overcome by gas. In falling his legs got caught in the

ladder which held him, head downward. The two men, Angus Soari and Otto Ramner, noticed the deceased's hat falling down the raise and also that his light was out. They ascended the ladder about 30 feet to investigate, when they were overcome by gas and fell from the ladder to the bottom of the raise. The shift boss, Thomas Cosgrove, was then called and he went up the raise and brought down the deceased. The two men who fell down were easily brought to, but efforts to resuscitate the deceased were futile. The death was no doubt caused by the carelessness of the deceased in not turning on the air as soon as he went into the raise.

The coroner's jury brought in the following verdict: "That the said Emil Mikkalo came to his death September 28th in the raise of the Kendall shaft of the Nipissing mine by being accidentally overcome by gas."

On October 31st at 4 15 a.m., Joseph Girard, machine-man, was killed in a cage. The accident took place at the Kendall shaft. Deceased had fired a round of holes just before midnight and again at 2 a.m. The workmen in this part of the mine (east drift) then waited on the surface until 4 a.m. for the smoke and gas to clear. One cage load of four men went down, and when the cage returned to the surface Girard and his partner got on it and went down. The deceased when about 50 feet from the shaft in the east drift, turned back without saying anything to his partner, went to the shaft, rang one bell in place of three and got on the cage. When the engineer had hoisted about 80 feet he felt the cage stick and shut off steam. He tried to lower but could not. The hoistman informed the shift boss, who went down, but in the meantime men working on the first level had found Girard lying on the cage caught between the shaft timber and the floor of the cage, his head and one shoulder being off the cage. Not more than 3 to 5 minutes elapsed from the time the cage stuck until he was taken out, but he was quite dead. Death was due to fracture of the neck and pressure thereon. The deceased must have collapsed while on the cage, from some cause, and in falling his head and shoulders were caught by the timber. All requirements of the Mining Act had been fulfilled.

The coroner's jury returned the following verdict: "That the said Joseph Girard was found dead in the cage near the 100-foot level in the Kendall shaft about 4.30 a.m., October 31st, and that the said Joseph Girard came to his death by some unknown or accidental cause. We would strongly recommend that more precautions be taken that men working together be able to understand each other. We would also recommend that immediate action be taken to prevent men of different nationalities working together who do not understand each other."

At the Meyer shaft, November 25th, at 9 p.m., George Thomson, drill-helper, was instantly killed. The deceased with three other men was at the bottom of the shaft, which was 113 feet deep. The lander, Allaire, at the top of the shaft, placed six long steel in the bucket while it was hanging in the shaft. This was contrary to the rules. When the lander was in the act of tying the steel one of the men in the shaft, J. Quelne, rang two bells for the bucket to be lowered. The hoistman thereupon lowered the bucket before the lander had time to tie in the steel. The lander stopped the bucket when it had got down about 20 feet in the shaft and then, instead of going down in the shaft and either warning the men or tying the steel in the bucket he let it go down, thinking it would be all right. While the bucket was going down, however, one of the pieces of steel in some way fell out, striking the deceased on the back of the head and killing him instantly.

The lander, Allaire, disobeyed the rules and warnings of the company in loading steel in the bucket while it was hanging in the shaft. Quelne also acted contrary to the rules in ringing down the bucket as he was told by the machine-man, Cote, not to do so.

The coroner's jury returned the following verdict: "We find that George Thomson met his death in the Meyer shaft of the Nipissing mine on November 25th by a steel falling from the bucket on his head, being killed instantly, and that we consider that this shaft is not fit for men to work in as it is now, and that the company be held responsible for his death. We further find that the Mine Inspector should make more frequent calls at the different working shafts, as this shaft has been worked for over a year and there is no evidence of it ever being inspected until this man was killed."

. Inspector Corkill inspected this shaft after the accident and reported it in very good condition.

#### Northland Mining Company

At Rib lake, T. & N. O. Railway, on May 11th at 4.10 p.m., J. Burke and A. Burke drilled into an old bottom in which the powder had not all exploded. The powder going off, the two men were injured, one slightly and one more seriously, but not dangerously. The men were sinking a shaft which at the time was down 170 feet. The men who quarried out the bottom state that the shaft was well quarried before the machines were let down.

On December 28th at 2 p.m., D. Foley machine man, was killed. Deceased and another man were working on the first level, north stope, engaged in cleaning off the benches. While doing this work Foley, who was on one side of the raise on the stope, was struck by a piece of rock falling from the roof, and fell off the bench on which he was working into the raise. This raise is about 60 feet in depth and vertical. Foley was found lying on the timbers at the bottom of the raise, was taken to the surface and died in a short time. The roof above the stope is about 25 feet in height, and had been scaled, according to the evidence of the superintendent, S. Shovell, during the week of the accident.

The coroner's jury returned the following verdict: "That we believe that the deceased D. Foley came to his death by falling down a chute at the Northland Mining Company's mine at Rib lake, and that such death was accidental."

#### Nova Scotia Mine

On July 13th in the afternoon, Allan James McMillan, machine man, fell down a winze and died as a result of the injury two days later. Deceased had gone down to the second level by the shaft. He walked along this level, carrying a light, until he came to the winze, his intention being to go down the ladder. Deceased must apparently have tripped over something causing him to fall down the winze, because after the accident the sole of his boot was seen to have been pulled off. No guard nail had been placed at the winze by the company as is required by the Mining Act.

The coroner's jury returned the following verdict: "That the said Allan James McMillan on July 13th received certain injuries by accidentally falling down a winze in the Nova Scotia mine, which said winze was not protected by guard rails through the incompetent management of said Nova Scotia Mining company, from which injuries aforesaid the said Allan James McMillan did on July 13th die in the hospital situate in the town of Cobalt."

#### O'Brien Mine

On December 12th at about 10.30 a.m. while the ore sorters at the rock-house of No. 1 shaft were at work, one of the men found a piece of dynamite about two inches long in the muck. He handed it to the rock-house foreman, Geo. Hinds. The latter asked Irwin Keene, shift boss, if the dynamite was dangerous when it was frozen. Keene told him it was and ordered him to take it to the thawing house. Hinds remarked he had a few pieces on a shelf in the corner of the rock-house. Keene ordered all of it to be taken to the thawing house. Hinds then proceeded to the corner

of the rock-house where these loose pieces were, and started to take them down from the shelf when an explosion occurred. Three or four men were standing close to the deceased at the time of the explosion, but were not hurt. Hinds was killed instantly. Both dynamite and gelignite were being used in the mine, so that it is not known which substance exploded. The cause of the explosion is unknown.

The coroner's jury returned the following verdict: "That the said George Hinds came to his death in the ore-house of No. 1 shaft of the O'Brien mine from injuries received by an accidental explosion of a piece of dynamite held in the hands of the deceased, and so the jurors aforesaid do say that George Hinds in manner and by the means aforesaid accidentally, casually and by misfortune came to his death, and not otherwise."

#### Paterson Mine

On June 1st at 10 a.m. Shirley Hayden, miner, was killed by a premature explosion. The deceased and his partner, Henley, had loaded six holes in the shaft, with 50 per cent. dynamite and 4½ foot Bennett's fuse. Hayden lighted the fuse and Henley started up the ladder, the deceased stepping into the bucket to go up in it. The bucket was just raised off the bottom when the blast went off. Henley was knocked off the ladder, but was able to climb to the surface. The deceased was probably killed instantly. The accident can be attributed to one of two causes:—First, that the fuse was defective and burned quickly, or secondly, that the holes were improperly tamped and the fuse spit into the holes, causing the dynamite to explode.

The coroner's jury returned the following verdict: "That the deceased, Shirley Hayden, came to his death on June 1st, 1908, on the property of the Paterson mine, from injuries received in a dynamite explosion from causes unknown."

#### Right of Way Mining Company

At the Right of Way mine, February 15th, at 4.15 a.m., Constant Constot, machine helper, was killed and his partner, E. Bernier, was slightly injured, by an explosion of gelignite. The two were drilling in a cross-cut which had not been worked since November, 1907. The accident resulted from drilling into a hole in which there was some gelignite which had failed to explode at the time, and whose presence was unknown to either the machine-man or the management. The hole had been drilled in about ten inches when the explosion occurred. It had not been started in the old bottom, but had apparently run into it, since the hole was at a much greater angle than the old one. The manager, Mr. J. Houston, stated positively that there had been no miss-fires in November when work was last done here. This is borne out by the fact that about 4½ feet had been made in the last round, which would not have been the case if there had been a little explosive left in the hole. The captain stated that he had been in the crosscut several times and had not seen any evidence of a cut-off or missed hole.

The coroner's jury returned the following verdict: "We find that Constant Constot came to his death in a drift in the Right of Way mine by an explosion due to the incompetency of Emil Bernier (machine runner) and gross negligence on the part of the management in not having examined the abandoned drift, and further in employing unskilled miners."

#### St. Lawrence-Cobalt Mining Company

On island 13 Sasaginaga lake, September 8th, about 10.30 a.m., M. Banville, foreman, was injured by an explosion of gelignite, causing his death on the 12th of the same month. Deceased was working in the shaft which was about 55 feet deep. A round of eight holes had been fired and all reports counted on the evening of September 5th, and mucking had been done on the 6th and 7th and up to the time of the accident. Deceased had been in the habit of going down in the shaft after all the muck was out to pick up any loose rock from the bottom. While in the shaft just prior to the accident deceased had sent up two buckets of muck and two of water, when an explosion was heard. He shouted to the man at the top to hoist him to the surface, which was done and medical aid procured. From the evidence it appears that deceased was a careful and competent foreman. He apparently met his death through the accidental picking into the bottom of an old hole in which was a small piece of unexploded gelignite.

The coroner's jury returned the following verdict: "That the deceased Marcell Banville came to his death from injuries received accidentally, and his death was not caused by any fault of the company or by his own incompetency."

### Temagami Gold Reefs Company

This property is situated about four and a half miles from Temagami station, T. & N. O. Railway. On December 9th about 11.20 a.m. M. Dougherty, laborer, and A. Rioux, hammerman, were killed by an explosion of dualin, and W. Brennan, F. Lavally and E. Lalonde were injured. The men were working in a shaft 40 feet deep. On December 7th a round of holes was fired. On mucking out it was found that one hole which had been drilled about 4 feet deep had only broken about one foot off the top. The foreman had put a plug in this and another round was drilled. After all these holes in the round were drilled, the foreman, E. Lalonde, directed Dougherty and Rioux to clear out this old hole so that they could reload it, and, according to the evidence of H. Parker and W. Lavally, to drill it 8 or 10 inches deeper. The foreman then went to the surface to get the powder to load the holes. He was gone about ten minutes, and had got down in the shaft with the powder when he saw the men hammering a steel in this old hole. He had only got to the bottom when the explosion occurred. The explosive was dualin

The coroner's jury brought in the following verdict: "That the said Alphonse Rioux came to his death on the 9th day of December, 1908, from the accidental explosion of a partially exploded charge of dualin in a hole which the deceased was cleaning out, and that the said accident was due to the negligence of the Company in using dualin instead of dynamite, and that we consider that the men employed by the Company were insufficiently experienced miners."

### Temagami Mining and Milling Company

On January 3rd at 4 p.m. Andrew Gowanlock, machine helper, was instantly killed by an explosion of gelignite. Four holes had been loaded and fired during the morning. The deceased considered that all the holes had gone off, while his partner thought that one had missed. Both returned and proceeded to muck and look for missed hole. Gowanlock hit the hole with his pick, resulting in an explosion which killed him instantly.

### Trethewey Silver-Cobalt Mine

At the Trethewey Mine about 8 p.m. January 1st, George Keilty, machine helper, was killed instantly through a shaft bucket falling on him from the 50-foot level to where he was at work about forty feet lower sinking a shaft. The bucket had been taken off the cable at the 50-foot level shortly after the men went on shift, and had presumably been placed on top of a hose. The shift boss and helper were attempting to take this hose down the shaft, and in so doing the bucket must have been upset and rolled down.

The condition of the shaft at the time of Inspector Corkill's inspection was in accordance with the Mining Act, but it had apparently not been so at the time of the accident, as new guard rails had just been put in. If these guard rails had been in position at the time of the accident, they would have prevented the bucket rolling into the shaft.

The coroner's jury returned the following verdict: "That the cause of death of the said George Keilty was injuries received by the falling on him of the bucket from the 50-foot level of said shaft of said mine, that the falling of said bucket was caused by gross negligence and incompetence on the part of the shift-boss, Stephen Monk, and that there was gross negligence on the part of the company."

On June 10th at 10 p.m. James Harrington, hoistman, was accidentally killed. At that hour George Ferguson, shift-boss, signalled from the second level of the No. 2 shaft to the hoist house to hoist the bucket and stop it at the first level. The bucket was hoisted as usual, but it did not stop at the first level. A workman named Hart was sent to the hoist house, and found the deceased lying with his head under the drum and his feet between the levers and cylinders. The hoist was the usual pattern of

6 x 8-inch cylinder Jenckes manufacture, with levers in quadrant. After starting the hoist, which is operated by air, the deceased apparently stepped to the side of the hoist and took hold of the cable, which was probably not winding properly on the drum. In doing so his coat sleeve got caught between the cable and the drum, and the revolving of the drum threw deceased over it, his head striking on the metal casting of the base of the hoist. The hoist was as well guarded as was practicable. Inspector Corkill, who made an investigation, considers deceased was to blame in leaving the lever while the hoist was running, and also for touching the cable while the hoist was in operation. If the cable was not winding properly on the drum, the hoist should have been stopped and the difficulty remedied.

The coroner's jury returned the following verdict: "That the said James Harrington came to his death on Wednesday night June 10th in the year 1908, in the hoist-house, by accidentally getting caught in a piece of unprotected machinery, and that they recommend that a hood be put over the cog-wheel of the hoist in the above mentioned mine."

### Victoria Silver-Cobalt Mine

On May 18th at 9 a.m. at the 150-foot level, shaft No. 2 north cross-cut, George Harris, foreman, had his eyes and other parts of the body seriously injured by an explosion of gelignite. A round of holes was blasted in the cross-cut on May 15th, and one report was short. The men who had done the shooting had visited the drift after the shot and before the accident, but could find no missed hole. No work had been done since the blast. On the morning of the accident, Mr. Harris went in to examine the cross-cut and pulled down a loose piece of rock from the drift. Immediately his hand touched the rock, the explosion occurred. Captain John Harris considers that the accident was caused by a piece of gelignite, which had not exploded, being in the bottom of the hole, and which was set off when Mr. Harris picked down the piece of loose rock.

### Wilbur Iron Mine

On May 19th at about 10.20 p.m. John Warrington was killed by a piece of rock falling on him. Deceased was working in first level of the mine about 45 feet from the surface. A round of holes had been blasted in this stope during the day shift, and the man and his helper had been engaged from 10 a.m. to 4 p.m. in scaling the roof, which was, at the time when the man was killed, about 15 feet in height. The deceased had come to work on the night shift, and had been engaged in breaking up or blasting large pieces of ore for the trammers. At the time of the accident he was breaking up ore by means of a sledge when a piece of rock fell from the roof, striking him above and below the right eye and causing a fracture of the base of the skull. Death resulted six minutes after the blow. From the evidence it would appear that the roof had been reasonably scaled.

The coroner's jury returned the following verdict: "That John Warrington came to his death through the accidental falling of a rock in the mine, due to an oversight in scaling of which in any case there would have been a possibility, and we do strongly urge, that still greater precautions be taken in the future in the scaling of the different chambers of the mine, and in all other kinds of work in which there is thought to be any danger whatever."

### Kingston Feldspar and Mining Company

On October 8th Tobias Legary, who was not an employee of this company, was standing on the tramway talking to his brother who operates the line. The car ran partly over his leg, inflicting a superficial flesh wound about 2 by 2½ inches. It was not considered serious at the time, but later on tetanous developed and Legary died on October 14th.

Following is a summary table of the accidents described above:

## Table XVII. Mining Accidents in 1908.

| Date. | Mine or Works. | Name of Injured Person | Slight. | Serious. | Fatal. | Above ground. | Below ground. | Nature of Injury. | Cause of Accident. |
|---|---|---|---|---|---|---|---|---|---|
| 1908. | | | | | | | | | |
| Jan. 1.... | Trethewey Silver-Cobalt Mine.... | George Keilty.......... | ... | .... | 1 | .... | 1 | Killed instantly ...................... | Fall of bucket down shaft. |
| June 10.... | do .... | James Harrington...... | .... | .... | 1 | 1 | ... | Killed instantly ...................... | Caught in hoist. |
| Jan 25.... | Canadian Copper Co., Crean Hill mine.......................... | Rosario Therien ........ | .... | .... | 1 | 1 | .... | Leg crushed, died following day from loss of blood ......... ........ .... | Fell from empty ore car. |
| Feb. 28.... | do do | Augusti Miettinen...... | .... | .... | 1 | .... | 1 | Killed instantly ...................... | Riding in skip. |
| Mch. 23.... | do (Copper Cliff) | Jno. Kangas ....... .... | ... | .... | 1 | 1 | .... | Killed instantly ..... ............... | Run over by slag train. |
| April 10.... | do (Creighton) | John Heittala .......... | .. | .... | 1 | .... | 1 | Died next day ......................... | Struck by piece of ore causing fall of 50 feet |
| May 29.... | do (Crean Hill) | August Sapola....... ... | ... | 1 | .... | .... | 1 | Serious injuries to eyes, nose and lips.. | Picking in muck causing explosion. |
| " 30.... | do (Creighton) | Commoso Davide.. .... | ... | 1 | .... | .... | 1 | Scalp wound and partial paralysis of one leg and arm..................... | Struck on head by piece of ore. |
| June 18 ... | do do | Andruch Bijko......... | .... | .... | 1 | .... | 1 | Head injured.............. ......... | Struck by rolling stone. |
| " 19.... | do do | Dimitru Lakatus ....... | .... | 1 | .... | .... | 1 | Loss of sight in one eye................ | Explosion of dynamite in muck. |
| July 16.... | do do | Tom Dominico ......... | ... | .... | 1 | 1 | .... | Crushed to death...................... | Caught between post and car. |
| Aug. 10... | do (Crean Hill) | Megali Gordi ........... | .... | .... | 1 | 1 | .... | Killed instantly .................. ... | Run over by ore car. |
| " 13.... | do (Naughton Quartz Quarry) | Oscar Lanthanon....... | .. | .... | 1 | .... | 1 | Skull fractured ....................... | Struck by rock, causing fall from machine. |
| Sept. 8.... | do (Crean Hill) | Mike Duisdank ......... | .... | .... | 1 | .... | 1 | Brain injured...................... .... | Struck on head by falling stone. |
| " 23.... | do (Creighton) | Jamb Cottock........ .. | .. | ... | 1 | .... | 1 | Fracture of skull...................... | Struck by piece of ore, causing fall. |
| Jan. 29.... | Nipissing Mining Co.............. | E. Belanger............ | 1 | ... | .... | 1 | ... | Pieces of rock blown into face by detonator.......................... ........... | Picking into rock. |
| Feb. 11.... | do .............. | Thomas Roi ............ | .... | 1 | .... | .... | 1 | Right eye destroyed.................. | Explosion of gelignite in cut off hole |
| Mch. 25.... | do .............. | Panfilo Chiocchio ...... | .... | .. | 1 | .... | 1 | Killed instantly ..................... | Premature explosion. |
| April 1.... | do ............ | P. J. Leanny ........... | ... | 1 | .... | 1 | .... | Loss of left eye ....................... | Picking into muck containing explosive. |
| | | M. E. Dougherty........ | 1 | .... | .... | 1 | .... | Slight injuries..... ...... ......... ... | |
| | | A. Dubreuil............ | 1 | .... | .... | 1 | ... | Slight injuries....................... | |
| Sept. 28 ... | do ............. | Emil Mikkalo ......... | .... | .... | 1 | .... | 1 | Asphyxiated........................... | Fumes of explosive. |
| Oct. 31.... | do ............. | Joseph Girard .......... | .... | .... | 1 | .... | 1 | Neck fractured ........ .............. | Caught in cage. |
| Nov. 25.... | do ............. | Geo. Thomson.......... | .... | .... | 1 | .... | 1 | Head struck by falling steel........... | Steel fell from bucket being lowered in shaft. |
| Feb. 15.... | The Right of Way Mining Co .... | C. Constot ......... .... | .... | .... | 1 | .... | 1 | Killed.... ...................... ....... | Drilling into hole in which some gelignite had failed to explode. |
| " 17.... | Drummond Mines .............. | H. Evans ............. | 1 | .... | .... | .... | 1 | Slight injuries......... ............. | Riding in bucket. |
| | | W. E. Englehott...... | 1 | .... | .... | .... | 1 | | |
| April 10.... | Helen Iron Mine................. | John Calligaro........ | .... | 1 | .... | 1 | .... | Injured right eye....... .... ........ | Breaking of hammer. |
| " 17.... | do ................ | Johan Maki ............ | 1 | .... | .... | .... | 1 | Sprained ankle.... ..... .............. | Fell from staging. |
| May 1.... | do .... ......... | Matti Kinnarl.......... | 1 | .... | .... | .... | 1 | Dislocation of shoulder-joint........... | Struck by descending cage. |
| June 25.... | do ................ | Wasyl Suilga .......... | 1 | .... | .... | .... | 1 | Finger crushed.. ...................... | Dumping ore. |
| July 5.... | do ...... ....... ... | Iwan Prodanink....... | 1 | .... | .... | .... | 1 | Leg crushed ........................... | Struck by falling ore. |
| " 14.... | do ................ | Jan Straivinski......... | 1 | .... | .... | .... | 1 | Two fingers ... ...................... | Caught between two cars. |
| " 28.... | do ...... ......... | J. L. Svanson .......... | 1 | .... | .... | .... | 1 | Thigh crushed............ ........... | Caught between two cars |
| Aug. 27.... | do .......... ..... | Wm. Nyholm.......... | 1 | .... | .... | .... | 1 | Ankle sprained and leg bruised ........ | Slipped 15 feet down stope. |
| Sept. 7.... | do ................ | J. Kakka .............. | 1 | .... | .... | .... | 1 | Finger jammed........................ | Struck by falling ore. |
| " 11.... | do ................ | J. De Diana........ .... | 1 | .... | ... | ... | 1 | Muscle of back strained ......... .... | Lifting ore into bucket. |
| Oct. 13.... | do . ............... | W. Feduke............. | 1 | .... | ... | ... | 1 | Bruised leg............................ | Hit by piece of falling ore. |
| " 13.... | do ................ | John Kielec............ | .... | 1 | .... | .... | 1 | Head and shoulder bruised............ | Hit by piece of falling ore. |
| " 13.... | do ................ | C. Agnese.............. | 1 | .... | .... | .... | 1 | Hand cut............... ......... .... | Hit by piece of falling ore. |
| " 17.... | do ...... ......... | John Jachec........... | 1 | .... | .... | .... | 1 | Arm bruised......... ................. | Hit by piece of falling ore. |
| " 31.... | do ................ | P. Butorac............. | 1 | .... | .... | .... | 1 | Pelvic region bruised.................. | Caught between two cars. |

Table XVII.—Mining Accidents in 1908.—Concluded.

| Date. | Mine or Works. | Name of Injured Person. | Slight. | Serious. | Fatal. | Above ground. | Below Ground. | Nature of Injury | Cause of Accident. |
|---|---|---|---|---|---|---|---|---|---|
| Nov. 5 | Helen Iron Mine | Peter Czkucz | 1 | | | | 1 | Finger crushed | Struck by pieces of falling ore. |
| " 13 | do | Victor Kumpu | 1 | | | | 1 | Right ankle bruised | Tripod slipped. |
| " 19 | do | Sali Kuja | 1 | | | | 1 | Leg bruised | Struck by pieces of falling ore. |
| Dec. 11 | do | Wm Russell | 1 | | | | 1 | Finger crushed | Crushed when lifting a car. |
| May 4 | La Rose Mines | Napoleon Leonard | | | 1 | | 1 | Head injured | Premature explosion. |
| | | Stefan Saravana | | | 1 | | 1 | Top of skull blown off | |
| May 7 | Nancy-Helen Mine | Robert Lavine | | | 1 | | 1 | Fractured skull | Fell down shaft. |
| " 11 | Northland Mining Co. | A. Burke | | 1 | | | 1 | | Drilled into old bottom containing some explosive |
| | | J. Burke | 1 | | | | 1 | | |
| Dec. 28 | do | D. Foley | | | 1 | | 1 | Head injured | Struck by falling rock and fell down raise. |
| May 18 | Victoria Silver Cobalt Mine | George Harris | | 1 | | | 1 | Eye and other parts of body injured | Explosion of gelignite. |
| " 19 | Wilbur Iron Mine | John Warrington | | | 1 | | 1 | Fracture of base of skull | Hit by rock falling from roof of stope. |
| June 1 | Paterson Mine | Shirley Hayden | | | 1 | | 1 | Killed instantly | Premature explosion of dynamite. |
| " 5 | City of Cobalt Mining Co. | R. R. Hipkens | | | 1 | | 1 | Head injured, resulting in death, June 15 | Picking in muck causing explosion. |
| July 8 | Mond Nickel Co., Victoria Mines | Mike Kasmark | | | 1 | | 1 | Body crushed | Crushed by falling rock. |
| | do | Makxym Tryjormak | | | 1 | | 1 | " | |
| | do | Nicholas Belinski | | | 1 | | 1 | " | |
| Nov. 20 | do | Alex. Durboyk | | | 1 | | 1 | Fracture of skull | Struck by piece of falling ore. |
| Dec. 18 | do | Steve Kat | | | 1 | | 1 | Dislocation of neck | Getting into cage. |
| July 13 | Nova Scotia Mine | Allan J. McMillan | | | 1 | | 1 | Internal injuries | Fell down unprotected winze. |
| " 31 | French-Greensmith Mine | J. H. McDonald | | | 1 | | 1 | Asphyxiated. | Exposure to gas. |
| | | E. Foley | | | 1 | | 1 | | |
| | | M. Gillies | | | 1 | | 1 | | |
| Sept. 8 | St. Lawrence Cobalt Mining Co. | M. Banville | | | 1 | | 1 | Injuries to head. | Explosion of gelignite in old bottom. |
| " 12 | Kerr Lake Mining Co. | F. A. Whalen | | | 1 | | 1 | Killed instantly | Explosion of dynamite. |
| " 21 | Claim No. 223, Hubert Lake | A. Chabot | | 1 | | | 1 | Loss of right arm and fracture of right leg | Explosion of gelignite. |
| | | Chas. Spute | | 1 | | | 1 | Right arm fractured. | |
| Oct. 6 | Grey's Siding Development Co. | R. Blair | | 1 | | 1 | | Foot injured | Cut with axe. |
| " 8 | Kingston Feldspar & Mining Co. | Tobias Legary | | | 1 | 1 | | Flesh wound on leg from which tetanus developed | Cut by wheel of car. |
| Nov. 16 | Beaver Mine | Andrew Osman | | | 1 | | 1 | Killed instantly | Fell from bucket. |
| | | John Aha | | | 1 | | 1 | | |
| Dec. 9 | Temagami Gold Reefs Co. | M. Dougherty | | | 1 | | 1 | Killed | Drilled in bottom of hole which had been blasted, but in which some explosive remained. |
| | | A. Rioux | | | 1 | | 1 | do | |
| | | W. Brennan | | 1 | | | 1 | | |
| | | F. Lavally | 1 | | | | 1 | | |
| | | E. Lalonde | 1 | | | | 1 | | |
| Aug. 20 | The Keeley-Jowsey-Wood Mine | F. Nelson | | 1 | | | 1 | Serious | Riding in bucket. |
| | | M. Hytte | | | 1 | | 1 | Died from injuries | |
| Jan. 3 | Temagami Mining & Milling Co. | A. Gowanlock | | | 1 | | 1 | Killed instantly | Picked into missed hole containing gelignite. |
| Dec. 12 | O'Brien Mine | G. Hinds | | | 1 | 1 | | Killed instantly | Explosion of dynamite or gelignite. |
| " 17 | Buffalo Mine | E. Lavergne | | | 1 | 1 | | Scalded | Boiler explosion. |
| " 22 | Crown Reserve Mine | G. Paradis | 1 | | | 1 | | Check cut by rock | Explosion of detonator. |
| " 23 | Columbus Cobalt Silver Co. | W. Hamilton | | | 1 | | 1 | Died from injuries | Fell from bucket. |
| | | F. McNulty | | | 1 | | 1 | Killed instantly | |
| | | E. Martin | | | 1 | | 1 | Killed instantly | |
| | | | 26 | 11 | 47 | 15 | 72 | | |

## MINE ACCIDENTS

By E. T. Corkill, Inspector of Mines

The prevention of accidents in mines has been the subject of much discussion, both among mining men and by commissions appointed by the governments of various countries. Most of the commissions appointed have studied the subject chiefly in connection with coal mines, and have only touched incidentally on metalliferous mining. This has probably been due to the fact that more men are employed in coal mining, and that when an accident occurs in a coal mine from an explosion a large number of lives are involved. When this happens the press in every country calls attention to the accident, enlarges upon it, points out the great danger of the miner's occupation, and accordingly the government of the country in which the accident occurs is compelled to institute an investigation.

In metalliferous mining an accident seldom occurs in which a considerable number of men are killed, the fatalities usually being one or two at a time, though in the course of a year they may amount to a large total. Public opinion is, therefore, not aroused: the management of the mine is not so much impressed with the importance of careful supervision; the miners are awakened for a few days, and then forget, and the same conditions prevail as before. It is a common belief among most metal miners that the fatalities in coal mines far exceed those in metalliferous mines. This is a great mistake, and, while it is not proposed to argue that metal mining is as hazardous a calling as coal mining, still the writer desires to impress upon all metal miners that only care and close supervision of their work will lessen the number of accidents and place metalliferous mining on the list of the less hazardous occupations. In the United Kingdom the death rate per thousand men employed in 1907 in metalliferous mines was 1.08, while in the coal mines for the same year the death rate was 1.46 per thousand. The average death rate per annum for the ten years from 1898 to 1907 in the coal mines was 1.40 per thousand, and in the metalliferous mines for the same period 1.14 per thousand. This shows that only .26 more men per thousand per year were killed in the coal mines than in the metalliferous mines. In the German Empire the death rate in 1906 in coal mines was 1.70 per thousand men employed, and in metalliferous mines 1.29 per thousand. In the United States in 1906 the death rate in coal mines was 3.21 per thousand, while in the same year in metalliferous mines in the States of Colorado, Michigan, Missouri and Montana, the death rate of 3.22 per thousand. The percentage of accidents in metalliferous mines in these states is therefore slightly greater than in coal mines.

The necessity for action to prevent accidents in metalliferous mines in the United States was recognized by the American Mining Congress at its annual meeting in November, 1906, when a committee was appointed to prepare a law suitable to modern conditions governing quarrying and metalliferous mining, with the view of its adoption by the American Mining Congress and recommendation to the various states of the Union for its passage as a uniform law replacing existing laws, which in the best cases were more or less imperfect and out of date. The laws of the states of Colorado, Missouri, Montana and New York, were published by the Congress, to enable those concerned to criticize the existing laws and thereby assist the committee. No uniform set of laws has as yet been adopted by the Mining Congress. In Canada, the Provinces of Nova Scotia, Quebec, Ontario and British Columbia have regulations controlling the operation of metalliferous mines. In the Transvaal in 1905 a commission was appointed to inquire into and report upon "The use of winding ropes, safety catches and appliances in mining shafts." The report of this commission was published in 1907, giving in detail the result of the inquiry. Various commissions and boards of inquiry have been appointed in the United Kingdom since 1855, some of which have

investigated the causes of accidents in metalliferous mines, and laws have been enacted to prevent certain dangerous practices. As a result, the death rate in the United Kingdom in metalliferous mines is practically the lowest of any of the countries in which metalliferous mining is a considerable industry.

### Causes of Accidents.

Accidents in mines may be classified under three headings, namely:—

1. Unavoidable accidents that are inherent in the nature of the work.
2. Accidents due to carelessness, negligence or incompetence on the part of the management.
3. Accidents due to carelessness, negligence or incompetence on the part of the workmen.

An interesting table is published by the German government, classifying the mine accidents in that country for the year 1906, and indicating the contributory causes as follows:

| | Per cent. |
|---|---|
| Accidents owing to danger inherent to the work itself | 69.31 |
| Accidents due to defects in the mine workings | 00.78 |
| Accidents through fault of fellow workmen | 3.24 |
| Accidents through fault of injured person | 26.67 |

This table shows a most satisfactory state of affairs in the case of the German mines, since .78 per cent. only of the accidents resulted from defects in the workings. It is a condition which might quite readily be attained in our mines in Ontario, but only through the active co-operation of all the mine managers in the Province.

In Ontario in 1908 the total number of accidents was 69, resulting in 47 fatalities, of which 39 occurred below ground and 8 above ground. Of this number, 23.4 per cent. of the fatalities resulted from falls of ground; 27.6 per cent. from shaft accidents, 23.4 per cent. from accidents caused by explosives; 8.5 per cent. from miscellaneous accidents underground, and 17.8 per cent. from accidents on the surface.

The following table shows the cause and place of the fatal accidents in Ontario in 1908:—

| | | |
|---|---|---|
| Falls of ground | | 11 |
| Shaft accidents— | | |
| Falling from bucket while riding contrary to Act | 6 | |
| Objects falling part way down shaft | 1 | |
| Falling into shaft from part way down | 2 | |
| Objects falling from surface down shaft | 1 | |
| Cage accidents | 2 | |
| Riding on skip | 1 | |
| | —— | 13 |
| Accidents from explosives— | | |
| Picking into old hole in which explosive had been left | 1 | |
| Drilling into bottom of old hole | 4 | |
| Picking into explosive in muck | 1 | |
| Premature explosion | 5 | |
| | —— | 11 |
| Miscellaneous accidents underground— | | |
| Suffocation from gases resulting from blasts | | 4 |
| Accidents on surface— | | |
| Machinery accident | 1 | |
| Struck or run down by train | 3 | |
| Boiler explosion | 1 | |

| | | |
|---|---|---|
| Explosion in rock house | 1 | |
| Miscellaneous | 2 | |
| | | 8 |
| Total for 1908 | | 47 |

Of the total number of accidents, 32 occurred in the Cobalt area, resulting in 30 fatalities.

From a close analysis of the fatalities in Ontario in 1908 it is found that 44.7 per cent. resulted from danger inherent in the nature of the work, 31.9 per cent. through neglect or carelessness of the management, 8.5 per cent. through the fault of a fellow workman and 14.9 per cent. through the fault of the injured person.

In the gold mines of the Transvaal in 1906 there were 815 employees killed. The deaths resulted from the following causes:

| | |
|---|---|
| Explosives | 199 |
| Overwinding | 15 |
| Travelling in cage or skip | 47 |
| Struck by cage, skip or hauling rope | 47 |
| Travelling by ladders | 14 |
| Falling in shaft and excavation | 67 |
| Falling of materials | 59 |
| Fall of ground | 198 |
| Inundation by water | 55 |
| Winding ropes and connections | 37 |
| Tracks and tramways | 17 |
| Boiler and steam pipes | 9 |
| Machinery | 16 |
| Electricity | 6 |
| Miscellaneous | 29 |

This is a death rate of about 5 per thousand men employed.

In the metalliferous mines in Spain in the same year, the total number killed was 272, or a death rate per thousand men employed of 2.30 per cent. These fatalities were apportioned as follows:

| | |
|---|---|
| Fall of ground | 70 |
| Explosion of fire damp | 3 |
| Blasting | 29 |
| Suffocation | 7 |
| Inundation of water | 1 |
| Falling down shaft | 37 |
| Breaking of machinery | 61 |
| Miscellaneous | 64 |

In four of the chief mining states of the United States in 1908 the following table shows the numbers of fatalities:

| —— | Persons employed. | Deaths. | Deaths per 1,000 employed. |
|---|---|---|---|
| Colorado | 34,790 | 82 | 2.36 |
| Michigan— | | | |
| Houghton County | 16,506 | 44 | 2.67 |
| Marquette | 5,840 | 22 | 3.77 |
| Missouri | 13,233 | 51 | 3.85 |
| Montana | 15,000 | 52 | 3.47 |

A large proporition of accidents will be classified by mine operators as unavoidable. It is quite true that a number of accidents do come under this heading. Certain accidents from explosives are very difficult to guard against; but, even from explosives, ignorance and carelessness are responsible for the greater number of the accidents. Possibly one of the greatest dangers, not easily avoided, is the fall of large blocks of ground, blocks that the ordinary scaling test of sounding will not detect. While sounding is a safe test for small pieces of loose ground, the foreman should see that the walls and roof are watched very closely for any sign of cracks or fissures in the rock. Shaft accidents are in the majority of cases inexcusable.

#### Accidents from Fall of Ground

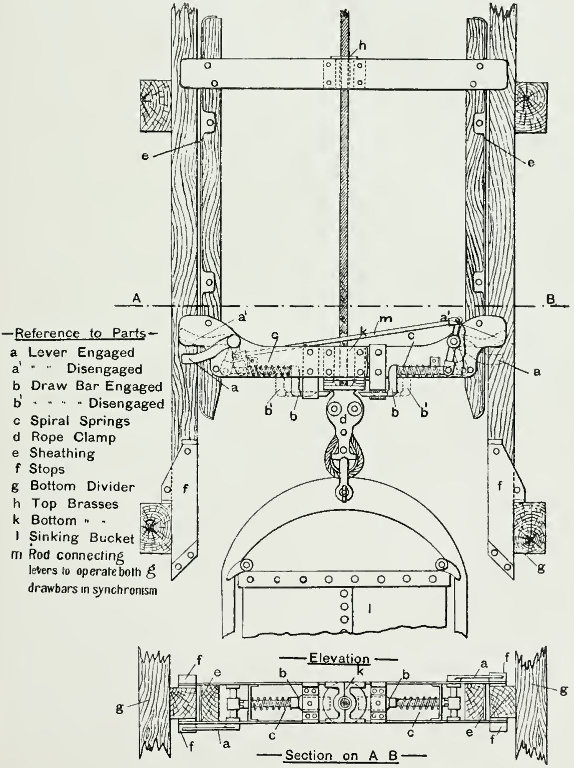
This is a class of accidents all too frequently classed as "unavoidable," but the responsibility for which rests both with the management and with the men. The management affirm that they always delegate their best men to do the scaling, and as they are usually the machine men and have to work under this ground, they will naturally wish to protect themselves. Superficially considered, this would appear to be a sound contention; but miners who have worked underground for years often come to regard the dangers of the occupation with contempt. Moreover, when the scaling should be done and in addition the drilling required of a shift, the men are not likely to waste any more time away from their machines than they can avoid. Hence the poor mucker is generally the victim, for the statistics show that this class of labor usually suffers the most from falling ground. In some mines it is found that the stopes are worked in such a way that it is almost impossible to keep the back properly scaled. This is due at times to the stinginess of the company in attempting to save money in carrying the levels too far apart for safe working, and at other times to the method of working, which makes the scaling of the roof practically impossible. In some mines supervision of the scaling of the stopes is so lax as to be absolutely useless. The manager relies on the superintendent, the superintendent on the foreman, and the foreman on the men. The foreman or shift boss cares more about making his hoist of ore large than he does about safeguarding the employees. It is often the practice of the superintendent to get the shift bosses "running" each other to produce the largest tonnage, and consequently they each try to throw the burden of scaling on the opposite shift, with the result that it is either not done at all, or else done very superficially.

In a low-grade mine tonnage is the big factor. The breaking down of floors on the level, leaving men working under a hanging of probably two, three or four hundred feet, which has not been scaled for years, and is, in fact, impossible to scale properly, is sacrificing human life to commercialism. The mucker is, as a rule, and at present in this country, a foreigner, usually lacking in sufficient intelligence to "size up" matters for himself. He has therefore to depend altogether on his fellow workmen in the mine to protect him, and this protection is not as a rule very great.

#### Shaft Accidents

In Ontario, during 1908, this class of accidents represented 27.6 per cent. of the total fatalities. These accidents occur chiefly from carelessness and violation of the recognized principles of safety in mines. The most prolific source of shaft accidents is bucket-riding. All of the accidents in Ontario from bucket-riding during the last five years have been caused by men riding in the bucket, not when sinking was going on between levels and the men were riding away from blasts, but when riding to and from work on the level. The mines in Ontario where buckets are used are for the most part shallow workings and the men, therefore, have no excuse for taking any unnecessary risk. The accidents are nearly all due to negligence on the part of the superintendent in enforcing the rules. Some superintendents attempt to excuse themselves by saying that it is impossible to prevent men riding in the bucket. Such excuses are inadmissible and are merely subterfuges to shirk responsibility. The practice of riding in the bucket while sinking shafts between levels is allowed by the laws of most countries, provided a chain ladder is always hanging in the shaft as an auxiliary means of escape. Very few accidents result from this compared with riding the bucket

from the levels. The use of crossheads in shafts has been condemned by a large number of mining men; but in several countries where inquiries have been made into their use, the consensus of opinion has been that the danger was lessened by the use of the crosshead, provided it was equipped with a safety appliance to prevent it hanging up in the shaft. The writer considers that where crossheads are used they should be either fastened so that they could not leave the bucket or else equipped with an approved safety appliance. In the Transvaal, the Berry safety catch, shown in the accompanying sketch, has given satisfaction.




The "Berry" Safety Catch, for Crosshead Guide of Sinking Bucket.

Accidents resulting from men falling into shafts both from the surface and from the levels are too common. The necessity of maintaining guard rails at shaft entrances at all levels of the mine cannot be too much emphasized. Not only should superintendents have all levels so guarded, but they should also see that the guard rails are always kept in position when the shaft is open. This need of guarding shafts is also applicable to winzes and stopes. When men will not or cannot protect themselves, it is the duty of the employer to protect them by all possible safety appliances. Another danger in shafts is from rocks or tools falling into the shaft either from the surface or from part way down. These accidents are practically all due to carelessness on the part of someone. Shafts in some instances are improperly protected by doors at the surface, so that material is liable to fall down the shaft when the bucket is dumped. Another danger is in leaving cars or trucks on the track near the shaft entrance at either the surface or level in such a position that a slight push or concussion from a blast causes them to move along the track into the shaft. Guard rails should always be of a sufficient height at the levels to stop any truck or car Another danger is from loading material, such as steel or timber, into a bucket while the latter is hanging in the open shaft, or from carelessness in fastening it in the bucket. When a bucket is used, material should never be loaded into it unless it is resting on a door over the shaft or swung clear of the latter, for even a careful workman is likely to make a mistake on occasion and allow material to drop into the shaft. The men working in the shaft are at the mercy of the men on the surface, and any careless act should be most severely punished.

Cage accidents happen from a great many causes, the most dangerous being overwinding or the breaking of the cable. This has been a subject of much inquiry in those countries where mining is carried on at considerable depth. The chief dangers we have to contend with in Ontario are carelessness in giving signals and in getting on and off the cages. In shallow workings it is a question whether permitting the men to ride on the cage does not contribute to the dangers of the occupation. Workmen are careless, foremen are careless. Why should they be allowed to endanger their lives any more than is necessary? Another practice which is fruitful of accidents is allowing men to ride on the cages with cars loaded with steel, timber etc. These are liable to be jarred loose and catch in the timbers, causing a serious accident at any time.

#### Accidents from Explosives

The most prolific source of accidents from explosives is picking into them, either in old bottoms or when lying loose in the muck, or drilling into old bottoms. In shaft sinking there is a considerable danger from this source which is unavoidable, and this very fact should lead to increased caution. The driller firing a round of holes in a shaft should be very particular in counting the reports, and if there are any reports short, this should be reported in person to the next shift, who should also be notified just where the holes were drilled, so that in mucking out, due caution may be used in picking up the bottom. The old theory held by some miners, that if the exploder is taken out of the hole there is no danger, is a misconception, and miners should be so taught. Superintendents and foremen, who fail to instruct the men under them properly, or who neglect to see that the men exercise due care, are much to blame for accidents arising from this cause. Accidents occasioned by picking into a loose explosive which has got into the muck from a cut-off hole are difficult to guard against. A wise precaution when dynamite is used is either to take the wrapper off the dynamite cartridge or to slit it so that if the dynamite does get into the muck it disintegrates, and is so scattered that sufficient does not remain in one spot to do damage. Another safeguard is to keep the muckers from using the pick too strenuously. It is as effective when mucking in drifts to use the pick for pulling the muck down, as to sink it up to the eye, to the great danger of the workman. The latter practice is simply energy uselessly expended.

Another source of accident is the introduction of an explosive with which the men are not familiar. This is especially true in the cold weather when the explosive requires to be thawed. Dynamite is the explosive to which long use has accustomed all miners. When thawing it they judge its readiness for use by its pliability. Other explosives, such as gelignite, even if pliable may not be properly thawed, and in fact the latter is fairly soft when partly frozen In the condition near its freezing point, gelignite is most dangerous, as is also dynamite. Superintendents should see that all explosives are in the thawing house, exposed from 4 to 6 hours to a temperature of 85 to 90 degrees F. If warm water is used, the temperature of the water should not be above 125 degrees F. Care should also be taken that the explosive shonld not be removed from the thawing house in cold weather until the miner is ready to load his holes.

In Ontario last year five men were killed by accidents classified under the head of premature explosions. These can only be caused by the fuse running if the holes are properly loaded and tamped. Quick fuse is responsible for a very small percentage of the accidents attributed to premature explosions. The chief cause is not tamping the holes, thus allowing the fuse to spit into the hole. Other causes are carelessness with lighted candles, or smoking while the holes are being loaded. The writer has known instances where a snuff from a workman's candlestick has fallen into the drill hole when it was partly loaded. Such accidents are generally attributed to quick fuse, as the man very seldom survives to tell how it happened. It is, however, recommended that both high grade fuse and caps be used, and if found satisfactory that no change be made. The men get used to one brand of fuse, the length of time it takes to burn, and govern themselves accordingly The use of different brands which have different speeds of burning will confuse the workmen. It would be a step in the right direction if manufacturers were compelled to make a fuse that would have a burning rate between certain limits.

Some miners, and even foremen and superintendents, have the idea that if a hole has exploded it is perfectly safe to drill into it. The foreman who orders men to do so is taking criminal chances, and the men who act in this way of their own accord are tempting fate. Still, many accidents happen as a result of such foolhardiness. How can men be expected to avoid this risk when those in charge will permit it or order it done?

A serious accident from suffocation occurred in the summer of 1908 in a 50-foot shaft near the Montreal river. The accident took place at a time in the summer when the atmospheric conditions were such that the gas from the explosives used in blasting hung heavily in the shaft. At such time increased precaution should be taken by the workmen to get the gases out of the shaft before entering it, no matter how shallow the workings. A little care taken in running the bucket up and down the shaft will generally clear it of impure gases. Some authorities suggest a spray of iron sulphate solution as a means of getting rid of poisonous gases from explosives. This might be applied with success in drifts in mines, in which, by reason of their length, the gases hang heavily after an explosion.

Accidents on the surface are generally due to carelessness or from the lack of reasonable precautions. Boiler explosions, if the boilers have been kept properly cleaned and regularly inspected, are nearly always due to insufficient water.

Accidents to workmen caught in machinery in power houses, smelters or concentrators, are almost always attributable to the fault of either the workmen themselves, or to the neglect of the management in failing to properly guard the machinery.

### Conclusion

A study of the detailed returns of mine accidents in Ontario, during 1908, will show that while some of the accidents were strictly unavoidable, others were attributable to such causes as improper mining methods, failure of appliances, lack of proper

supervision, and carelessless or ignorance of the miners. It has been suggested, and the writer believes such is the practice in some mining camps, that the mine managers should turn over for prosecution to the civil authorities any workman who is guilty of a dangerous act. This might be beneficial and under the present law could be done by laying information before the Inspector or Crown Attorney; but in a number of cases the foreman or superintendent would rather shield the guilty party, than lay information against him, if the offender happens to be one of his best workmen.

Lack of discipline in the mines, particularly in the Cobalt area, and lack of supervision are the two chief causes for a large number of accidents there. When we consider that 32.6 per cent. of the accidents which resulted in fatalities in 1908 in Ontario, were caused by neglect, carelessness or incompetence of mine managers, we are presented with a condition of affairs obviously requiring radical improvement. A lack of discipline and supervision, besides increasing the danger of the work, indicates a lack of mine efficiency and so influences detrimentally the cost of the output. This lack of supervision often results in some of the workmen being permitted to go underground while under the influence of liquor, in which condition they are a danger both to themselves and to those working with them. A fatal accident in the mine, apart from the fact that a life has been sacrificed, is very expensive for the mine itself. The whole mine force is disorganized for the time, the men are affected thereafter by the thought that another accident may happen, and this decreases the efficiency in their work while the cost of suits for damages brought by the relatives of deceased workmen, may often aggregate a considerable sum. The total loss to the company from a fatal accident would in most cases pay several times over for maintaining the mine in a proper manner, and for the adequate supervision of the mine workings. The manager of a mine should not depend altogether on those under him for the safety of the mine workings, for it is his duty to inspect those workings personally and to see that the mine is in a safe condition for his workmen. If he does not do this often, how is he to know that the superintendent and shift bosses are doing their duty? In a number of cases it is to be feared that shift bosses spend too much of their time inspecting a soft seat in the boiler house, or a warm spot alongside the pump, to properly supervise the work in the mine. It is not alleged that our mines do not have enough officials, as in some cases there are possibly too many and the work is shifted from one to the other until no one does it properly, but it is contended that the managers in a number of cases do not personally see that the mining work is properly looked after by their assistants.

There is no doubt that in a "boom camp" such as Cobalt has been during the last three years, there is a spirit of feverish speculation and unrest that tends to the disorganization, lack of discipline and loss in efficiency of both the men and those in charge. The excitement of stock speculation and the prospect of making money through the staking, and buying and selling of claims is too absorbing to admit of their entire time being devoted to their work at the mine. Careful foremen, conscientious superintendents and vigilant managers, who try to guard against all possible accidents and are always on the alert to prevent them, will, in time, instil into the minds of the men a like degree of care and regard for their own safety; while on the other hand if they are careless and reckless about the work of the mine, they can only expect their men to be the same, and they will have themselves to blame if the men do foolhardy things. It should be the first care of all mine managers to keep their mines in as safe a condition as possible. If this is done a higher degree of efficiency can be obtained, as the manager can gather around him the very best miners and keep them.

# MINES OF ONTARIO

BY E T CORKILL, Inspector

## I.—NORTHWESTERN ONTARIO

As in 1907, the greatest amount of actual mining work done in northwestern Ontario in 1908 was in the Upper Manitou Lake area.

Towards the latter part of the year a number of prospectors came out from Sturgeon lake with stories of rich gold strikes. A number of claims have been staked and recorded, and with the present facilities for getting to the lake, it is to be expected that considerable prospecting will be done during the present year. Sturgeon lake is by no means a new field. The Sixth Report of the Bureau of Mines contains a reference to the discoveries of gold there. In the Twelfth Report Dr. W. G. Miller describes the work done at the St. Anthony mine and the geology in the vicinity of the mine. Until the fall of 1908, when the Superior branch of the Grand Trunk Pacific railway was completed, the lake was difficult of access. A large deposit of iron pyrites has been opened up near the junction of the N. T. railway and the Superior branch of the G. T. P. railway. It is expected that shipping will be commenced with the opening of navigation in 1909.

The iron industry near Port Arthur has been dull during the year. Some of the silver mines on the Port Arthur and Duluth railway have been re-opened, but only small shipments have yet been made.

### Upper Manitou Lake Area

There were several properties here doing work in 1908, but the greatest activity was at the Laurentian mine.

#### Laurentian Gold Mine

Work has been carried on continuously at this mine since the inspection in 1907. The shaft has been sunk to the 400-foot level and development on the several levels actively carried on. On the first level the south drive is 270 feet in length and the north drift 190 feet. At a point 220 feet from the shaft a raise has been put up 35 feet and ore stoped out for 30 feet in length. On the second level at a depth of 200 feet the north drift has been driven 150 feet, and at 100 feet north of the shaft on this level, cross-cuts have been driven east 10 feet and west 20 feet. A stope has been carried up on this level to a height of 45 feet by about 80 feet in length. On the third level at a depth of 300 feet, the north drift is 180 feet in length and south drift 20 feet. At a point in the drift 165 feet north of the shaft cross-cuts have been driven east 15 feet and west 10 feet. About 150 feet north of the shaft a stope has been carried up 50 feet by 40 feet in length.

On the fourth level a station has been cut west of the shaft and drifts have been run north and south on the vein 100 feet and 75 feet respectively.

Instructions were given regarding riding in the skip, guard rails around the shaft openings, and the quantity of explosive to be kept in the thawing house.

The 20-stamp mill on the property was kept in operation the greater part of the year on the mine output.

Mr. R. B. Nickerson is superintendent, employing 30 men.

#### Paymaster Gold Mine

The main shaft on the Paymaster mine, owned by the Northern Development Company, was at the time of my inspection of the mine 300 feet in depth. No additional work was done on the first level of the mine beyond that described in former

Laurentian gold mine.

Detola gold mine.

reports. On the second level a cross-cut has been driven west 15 feet to the vein. Drifts have been run north 145 feet, and south 35 feet on the vein. At a point 45 feet north of the shaft a cross-cut has been driven east 45 feet and at the end of the north drift another in the same direction 45 feet. On the third level cross-cuts have been run 85 feet and 20 feet east and west from the shaft respectively. The vein was found on this level to have dipped across the shaft and a drift has been run on it from a point 20 feet east of the shaft a distance of 65 feet.

The shaft has been timbered, guides put in and hoisting done by bucket, a cross-head being used.

Instructions were given regarding ladder way and riding the bucket and the location of the boiler house.

Mr. Geo. Thow, the superintendent, informed me that plans were being prepared and preparations made for the erection of a stamp mill.

This mine is situated about one half mile southeast of the Laurentian.

#### Detola Gold Mine

Development work has been carried on continuously during the year on mining location H.W. 411, which lies north of the Paymaster and east of the Laurentian, by the Detola Mining and Development Company. Mr. G. R. Earley is superintendent.

The main shaft has been sunk to a depth of 105 feet and a new head frame erected. At the time of my inspection a new power plant was being installed consisting of two 50-h.p. return tubular boilers, a 3-drill straight line compressor and a 10 x 12-inch reversible hoist. The shaft was being re-timbered and preparations made for sinking it to a greater depth.

#### Victory Gold Mine

The Victory mine was in operation part of 1907 but closed down about the first part of 1908. While in operation the shaft was retimbered and straightened and some cross-cutting and drifting done on the first level.

Mr. J. Beck was superintendent in charge.

#### Minnehaha Gold Mine

This property, owned by the Minnehaha Mining and Smelting Company, is situated on the north side of Minnehaha lake opposite Beaudro's landing. All work at the property ceased in May, 1908, after having been carried on for about five months. The main shaft was formerly 100 feet deep and from the bottom of this shaft a 25-foot cross-cut was run. Some trenching was done and a prospect pit sunk to a depth of 25 feet. Mr. C. Good was in charge of the work.

### Lake of the Woods District

The mining industry in this district remains in the same condition as last year, there being no increased activity. No work of importance was done at any property except the Violet mine, owned by the Empire Gold Mining and Milling Company. This mine lies about 18 miles south of Wheeler station on the Canadian Pacific railway, from which place access is obtained to the mine by way of Lake of the Woods, Whitefish bay and several small rivers and lakes. A 2-stamp mill was erected during the winter of 1907.

### Sturgeon Lake

There was considerable prospecting in the Sturgeon Lake area last year. Some quartz samples fairly rich in gold were brought out by the prospectors, causing an influx of men to stake claims. The older properties on which considerable work has been done were, however, lying idle most of the time.

The work done at the St. Anthony Gold mine was fully described in the Seventeenth Report of the Bureau of Mines. Work at this mine was continued until the early part of the summer of 1908, when all operations ceased.

At the time of my inspection in August, 1908, little work was being done other than assessment work at any of the properties on the lake. The Superior branch of the Grand Trunk Pacific railway is in operation, so that access to the lake is now by way of the railway from Fort William to Wako, and thence by boat to the various mines. During 1909 access to the different parts of the lake will be made easy by steamboat connections, a couple of fairly large boats being placed on the lake mainly for hauling supplies for the National Transcontinental railway which passes to the north of the lake.

Cut 72 feet deep, Grand Trunk Pacific railway, near Vermilion pyrite mine.

Most of the activity during the last six months of the year was in the vicinity of Belmore bay, where both the Douglas Mining Company and the Belmore Bay Gold Mining Company have been operating at intervals for a couple of years. The gold occurs in a quartz gangue, sometimes intimately associated with galena and zincblende. Some of the quartz veins in the vicinity of the lake are of considerable width but are then not so heavily mineralized. At the St. Anthony mine the vein was open cut at the surface for about 150 feet along the vein, and 25 feet in depth. At some places in this open cut the vein was 20 to 25 feet in width. This was nearly all milled, but I was unable to ascertain the value of gold extracted per ton of rock crushed.

The present accessibility of the lake will no doubt help greatly in the systematic development of some of the prospects. Prospectors who are familiar with the Keewatin rocks find a very similar occurrence on the eastern and southern sides of the lake. The west shore of the north arm of the lake is mostly Laurentian.

### Vermilion Pyrite Mine

This mine has been described in former reports of the Bureau of Mines as the Northern pyrite mine, but the above name is that given by the present company.

On February 1st, 1908, development work at the mine received a set-back through the destruction by fire of the boiler house. A new boiler house was immediately erected and two 60-h.p. locomotive firing boilers were brought in and set up. The old hoist and compressor were found to be fit for use.

The shaft was, at the date of my inspection on August 3rd 1908, 154 feet deep with levels at 85 feet and 145 feet. On the first level a cross-cut has been driven south across the ore body 74 feet. A drift has been driven east on ore on the hanging wall side of the vein 50 feet and on the foot wall side east 110 feet and west 30 feet. These drifts are all in ore. On the second level a cross-cut has been driven across the ore

Vermilion mine, Northern Pyrites Company.

body 64 feet in length. As the shaft is vertical and sunk in the hanging wall it encountered the ore body near the first level. On the second level a cross-cut had to be driven north 16 feet from the shaft to reach the hanging wall. The vein is found to be dipping to the north at an angle of 61 degrees to the horizontal. The ore has been found by test pits 400 feet east of the shaft and 150 feet west, and again 350 feet west on the shore of the lake. A new shaft is being sunk in the foot wall of the deposit, having the same inclination as the vein. The vein is a hard, fine-grained pyrite, running from 45 to 48 per cent. sulphur. Parallel with the vein and about the centre of it, is a band or lens of quartz, shown to be about 12 feet in width where it has been cross-cut. The surface in the vicinity of the vein has a thick overburden. It has thus been impossible to see the relation of the quartz to the ore on the surface, or the walls of the vein. The rock appears to be a greenstone schist. About 400 feet south of the

vein is an outcrop of diabase about 30 feet in diameter. It is, however, impossible to detect its relation to the greenstone schists.

The shaft house is 55 feet in height with a shoot leading over a grizzly to a car where it is trammed to the stock piles.

An aerial tram to the Grand Trunk Pacific is to be built.

Instructions were given regarding riding the bucket.

Mr. J. Webb is superintendent in charge, employing a force of 30 men.

### Atikokan Iron Company

No work has been done by this company either at the mine or the furnace since last inspection. The management has been changed, and it is hoped that operations will be resumed during the present year.

### Port Arthur Silver Mines

Attempts were made during last year to re-open several of the old silver mines on the line of the Port Arthur and Duluth railway. No great success has as yet attended any of the efforts. A little work was done in one or two of the mines during the year. The West End Silver mine was kept pumped out for part of the year, but little or no mining work was done. The Porcupine, situated a couple of miles west of the Beaver mine, was pumped out and some exploratory work done. The most work accomplished in the district was at the Beaver mine, about 7 miles from Stanley Junction.

#### Beaver Mine

This mine has been re-opened by the Beaver Superior Silver Mines, Limited, of which Mr. Wm. Snider of Waterloo, Ontario, is president, and Mr. Henry C. Gibbs, New York, secretary-treasurer and manager.

No mining work was being done at the time of my inspection, the operations consisting of erecting a concentrating mill. This mill is being built by the Canada Pulverizers, Limited. The scheme of concentration is to feed the ore to coarse crushers, from which it is fed to four pulverizers, working in series. The pulp from these pulverizers passes to three concentrating tables.

The mining work done by this company consisted chiefly in following out some of the richer shoots in the stopes between the levels above the main adit level. Very little work has been done in the lower levels. The old dump, near No. 2 shaft, is to be treated in the mill first, the ore to be taken down through the No. 2 shaft and trammed out of the main adit level to the mill, which is built 100 feet distant from the mouth of the adit.

## II.—SUDBURY AND THE NORTH SHORE

There has been very little change in the developments in the mines in this area during 1908. The nickel-copper mines near Sudbury, owned by the Canadian Copper Company and the Mond Nickel Company, have been operated continuously. Both these companies now use electric power at their mines and smelters. The Mond Nickel Company began using electric power at Victoria Mines in April 1909.

A few of the copper mines on the north shore were in operation; only small shipments, however, were made. The Bruce Mines have again changed hands, this time being bought by Mr. R. W. Leonard, of St. Catharines and associates. Work was resumed at the mine late in 1908, after about 1½ years' idleness.

The copper smelter erected at Thessalon has not yet started to smelt ore.

In the Michipicoten district the Helen iron mine continues to produce largely and to be the mainstay of this section. A few of the gold properties were re-opened, and the mill at the Grace mine was in operation the greater part of the year.

## Gold

### Havilah Mine

This mine was formerly known as the Ophir mine and is referred to in the reports of the Bureau of Mines for the years 1892, 1893 and 1902. It is situated on the north half of the south half and the south half of the north half of lot 12 in the third concession of the township of Galbraith, district of Algoma, about 18 miles north of Bruce Mines. The Havilah Gold Mines, Limited, secured possession of the property in February, 1909, and have been engaged since that time in cleaning out the old adit, getting in machinery and repairing the buildings and stamp mill. Mr. John Knight, of Bruce Mines, is president of the company and Mr. S. H. Bryant manager. The shaft and adits were inaccessible at the time of my inspection on June 8th, 1909, but from the surface it can be seen that at least three shafts have been sunk. The main adit was being cleaned out and timbered, the old timber in it having given way. The 20-stamp mill with engine and boilers is in fairly good repair. A compressor and hoist were brought in during the winter and will be set up as soon as the old workings are cleaned out.

### Canadian Exploration Company

This company is opening up a gold property in township 69 about one mile south of Long Lake and nine miles south of Naughton. Mr. Geo. E. Drummond is managing director, and Mr. R. H. Hedley, superintendent. A shaft has been sunk on the ore to a depth of 100 feet and some testing done on surface. The ore consists of arsenopyrite and chalcopyrite in quartzite. The mineralized zone as shown by the gossan capping is about 90 feet in length and 70 feet in width outcropping on a quartzite ridge which is cut in places by diorite. To the south of this ridge granite is found. The property was originally owned by Major Leckie of Sudbury.

A power-plant consisting of a 200-h.p. water tube boiler and 10-drill compressor is being erected. A road from Naughton to the mine has been built by the Company.

## Canadian Copper Company

### Creighton Mine

During the summer of 1908 both No. 1 and No. 2 shafts at the Creighton nickel mine were worked and ore raised from the open cut. During the winter the work in the open cut was discontinued and all mining work confined to No. 2 shaft on the third and fourth levels.

No. 1 shaft is now at a depth of 320 feet with the third and fourth levels at 210 feet and 300 feet, while No. 2 shaft, which is sunk at a lower angle, is 390 feet with third level at 265 feet, and fourth level at 370 feet. The second level remains much the same as described in the last Report, except that the open cut has been widened and lengthened, now being 420 feet long on the level and 520 feet on the surface, with an average width of 160 feet on the level and 300 feet on the surface. On the third level No. 1 shaft the drift in line with the shaft has been run 170 feet north. This drift is connected with the cross-cut from No. 2 shaft by a drift 320 feet in length. On this drift at 70 feet from No. 2 shaft a section has been cut out on the ore body 260 feet by 75 feet. On the fourth level station has been cut at No. 1 shaft but no drifting done. At No. 2 shaft on this level a cross-cut has been driven 80 feet to the ore body, where a section has been cut 140 feet by 60 feet. On the third and fourth levels at No. 2 shaft the system of dry wall filling has been introduced, the filling and walls here being of ore, which will be recovered on the caving of the floor below. By this system the men are always within a short distance of the roof of the stope and the muckers are also protected in the tramways.

Mr. William Hambly is superintendent.

### Quartz Mine

The quartz mine near Naughton was worked part of the year. A deposit of quartz is being opened up by the company about 8 miles east of Sudbury near the main line of the Canadian Pacific railway.

### Cobalt Refining Plant

This plant, for the treatment of silver ores from the Cobalt camp, was in operation during 1908. No marked changes have been made in the process by which the silver is extracted.

### Nickel-Copper Smelting Plant

The only changes made at the smelter during the year were the completion of the converter plant and relining department, the rebuilding of the old cupolas and the

Creighton nickel-copper mine, showing buildings and partial view of open cut.

construction of two new ones. The plant is now equipped with 5 large cupolas arranged in row down the centre of the building, with the converter building alongside and parallel to it.

The officers of the company are: Mr. A. P. Turner, president and general manager, Mr. John Lawson, general superintendent, and Mr. D. H. Browne, smelter superintendent.

### Crean Hill Mine

An average production of about 300 tons of ore per day was maintained during the year. No sinking was done, the work consisting chiefly in operating the stopes on the first, second, fourth and fifth levels. A new system of mining is being introduced in the mine, namely, the dry wall and filling system. A certain percentage of the ground broken is rock, which was hoisted to the surface before this system was introduced. Now, the sorting is done in the stope and the rock used for filling and building the dry walls. Raises have been put through to the surface from the several levels and waste rock let down into the stope to be used to keep the filling up to within working distance of the roof of the stopes. The approximate area of the stopes on the different

levels as worked at present is as follows: first level open cut, 120 feet by 90 feet, at surface 190 feet by 140 feet; second level 240 feet by 80 feet; third level, floor broken through to fourth level; fourth level, 180 feet by 140 feet; fifth level, 150 feet by 80 feet. Raises have been put through between the different levels. Preparations are in progress for sinking the shaft to the sixth level.

The surface equipment remains the same as formerly described.

Mr. H. C. Meek is superintendent, employing about 400 men.

Crean Hill nickel-copper mine.

### Mond Nickel Company

The Mond Nickel Company shipped from both the Garson and Victoria mines during 1908. The production from the Victoria mine was curtailed owing to inadequate power. In August part of the aerial tramway between the smelter and the roast yard and the mine was destroyed by fire, which caused the smelter to be run on green ore for a time and finally to be closed down until the tram was repaired.

The power plant at Wabageshik falls on the Vermilion river, Lorne township, is now completed and is furnishing power to both the smelter and the mine.

#### Victoria Mine

With the installation of electric power and a new hoist and compressor, the Mond Nickel Company is in a position to carry the mine workings to a greater depth. Work is at present being done on the sixth, seventh, eighth, ninth and tenth levels. On the sixth level men are engaged scaling, preparatory to breaking through the floor. On the seventh level the floor of the west ore body is being broken down. On the eighth level the ore from the seventh level floor is being trammed out. Stoping has also begun below the eighth level floor on the east ore body, the ore being stoped out by means of underhand stoping to a raise from the ninth level. On the ninth level a section is being cut on the east ore body and the ore stoped from the west ore body above the level is being trammed from chutes. On the tenth level the section is being cut on the west ore body. The ore bodies are dipping to the east and the shaft is vertical; the ore is thus farther away from the shaft on each successive level. The distance between the eighth and ninth and between the ninth and tenth levels is 150 feet each. The shaft is being sunk below the tenth level, a depth of 50 feet having now been reached.

The new power plant at the mine consists of a double drum hoist, 6-foot drums driven by a 250-h.p. motor, drums working singly or in balance, and an air compressor developing 1,700 cubic feet of free air per minute, belt driven by a 300-h.p. motor. The hoist has a capacity of about 3 tons to a depth of 2,000 feet, hoisting at a rate of 1,000 feet per minute. The pumps in the mine are all driven by compressed air.

Instructions were given regarding hoisting men and scaling the roofs.

The smelter of the Mond Nickel Company at Victoria Mines is being remodelled. During the first part of the year electric power was introduced to drive all the blowing engines and pumps. The two furnaces have been enlarged to 180 by 44 inches and two new converter-stands are being installed.

#### Garson Mine

But little stoping was done at this mine during the year, the shipments having come from the levels, where full sections, 10 feet high, of the ore bodies are being cut.

On the first level at a depth of 100 feet, stope 11 has been continued south to 270 feet south of main cross-cut. The ore body is of varying width. Stope 12 has been followed to 230 feet south of cross-cut parallel to and west of stope 11. Stope 15 has been continued to 240 feet north of the cross-cut, and is 20 to 30 feet wide. A drift 130 feet long has been run from stope 15 to stope 14, which is 50 feet by 25 feet in area.

On the second level at a depth of 200 feet a cross-cut has been driven west 40 feet, where a drift has been run south 120 feet to stope 21, which is 160 feet long by about 50 feet wide. Stope 22 north is a long, narrow ore body, widening in places, and extends 250 feet northeast of the shaft. A drift 90 feet in length has been run from stope 22 to stope 23, which is 140 feet long by 30 feet wide.

On the third level, depth 200 feet, the ore bodies are nearly in line with the shaft. A drift has been run 175 feet south to stope 31, which is 180 feet in length and of irregular shape. From the drift to stope 31, a drift has been extended 231 feet northeast through stope 33. From the shaft to stope 32 is 100 feet north, and the stope is 160 feet in length by about 20 feet in width.

On the fourth level, depth 400 feet, the ore bodies are east of the shaft. The cross-cut east is 20 feet in length; from this drifts have been run south 40 feet and north 30 feet to stopes 41 and 42, which come together 60 feet east of the shaft. A pillar is thus left between the ore body and the shaft 80 feet in length by 30 feet in width.

The shaft has been sunk to the 500-foot level where a station is being cut. Instructions were given regarding guard rails at the shaft openings.

Mr. A. Sharp is resident superintendent.

#### Worthington Nickel Mine

Work was carried on at this mine during part of 1908 but closed down in the fall of the year. No opportunity was thus afforded for an inspection since last Report, or for seeing what work had been done.

#### Whistle Nickel Property

No extensive work was done on this property during the year. Some diamond drilling was done and a shaft sunk 50 feet.

It is owned by the Dominion Nickel Copper Company, of which Mr. J. N. Glidden is manager.

### Copper

#### Bruce Mines

This property was bought in the latter part of 1908 by the Bruce Mines, Limited, of which Mr. R. W. Leonard is president, and A. Longwell general manager. This company started work at once, and have since that time been working continuously underground with the exception of a few weeks lost time, caused by the burning of their power house in February, 1909. Work is being done chiefly on the fifth level. No. 2 shaft and third and fourth level west, No. 4 shaft. No. 2 shaft is 450 feet in depth and from the lower level drifts have been run on the vein east and west for a distance of 180 feet and 25 feet respectively. The fourth level of No. 2 shaft has been connected with the fourth level of No. 4 shaft by a drift 1,000 feet in length, this company having driven about 140 feet for a connection. All the hoisting from No. 2 working is done by means of a hoist on the third level, the rock being trammed to the abandoned stope, west, and the ore to the stope, east of the shaft, which has been partially stoped out. On the fourth level between Nos. 2 and 4 shafts a stope has been taken out of the roof to allow timbers to be put in for stoping. On the third level west between Nos. 2 and 3 dikes, stoping is being done.

No material change has been made in the surface plant. The boiler and power house was built to replace the one destroyed by fire and the machinery repaired. No work has yet been done at the concentrating mill, though some of the ore has been shipped from the mine for experimental purposes.

Instructions were given to put No. 2 shaft in proper condition.

#### Hermina Mine

No work was being done at this mine at the time of my inspection in March 1909, other than sinking the shaft from the 400-foot to the 500-foot level. Since last inspection work has been done on the second and third levels on both the east and west drifts on the ledge. On the second level east, a stope has been put up 13 feet by 27 feet in length. On the third level east, a stope has been put up 46 feet by 26 feet in length and west 18 feet high by 27 feet long. On the fourth level the stope is 25 feet high and 28 feet long.

A change has been made in the officers of the Company. Mr. James Chynoweth is president and general manager, Mr S. C. Chynoweth secretary, and Mr. Thomas Bowhay, superintendent.

#### Moose Mountain Iron Mine

The Moose Mountain iron mine did not send out much ore during the year, although some shipments were made. The docks at Key Inlet have been completed and it is expected that a regular output will be maintained during the season of navigation in 1909.

## Michipicoten Area

### Helen ron Mine

This mine, owned by the Lake Superior Corporation, continues to be the only large and steady producer of iron ore in Ontario. During the period of navigation from 900 tons to 1,000 tons per day are raised. It has been the policy of the company to stock-pile considerable ore during the winter when no shipping can be done. This custom was not carried out last winter, there being only such ore stock-piled as was taken out in development work.

No. 1 shaft has been deepened 50 feet, it now being 396 feet in depth, or the depth at which the fifth level is being run. The cross-cut from the fifth level station No. 1 shaft, has been driven 60 feet towards the No. 2 shaft, August 14th, 1908. It was the

Helen iron mine.

intention of the company to do all the development work on the fifth level during the winter, so that stoping could be begun with the opening of navigation. Most of the ore shipped during 1908 was taken from the fourth level. This level was being worked in manner similar to the third level, except that pillars were being left closer together. No iron pyrites was taken out in 1908. The ore on the north side of the ore body on the fourth level shows a distinct bedded structure, as if laid down or deposited by the action of water.

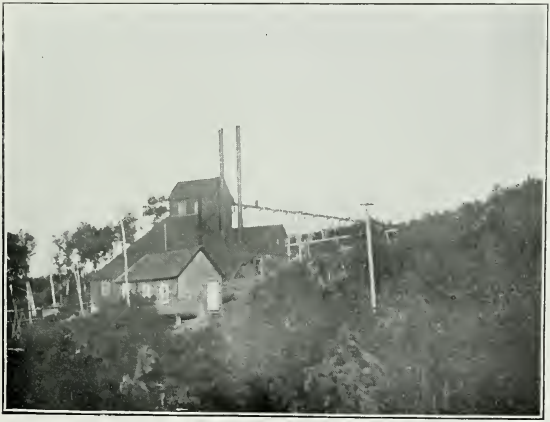
An average analysis of the ore now being shipped shows it to run as follows:

| | Per cent. |
|---|---|
| Fe | 59.4 |
| S | .07-09 |
| P | .13 |

Mr. A. A. Alsip was superintendent employing about 150 men, Mr. R. W. Seelye being general superintendent.

### Grace Gold Mine

The Le Page Gold Mining Company, of which Mr. Angus Gibson is manager, operated the Grace mine continuously during 1908. On the first level at a depth of 100 feet the ore has been stoped out for 150 feet along the vein and to the level. In the north drift on this level, 90 feet from the shaft, a cross-cut has been driven east 40 feet. At 150 feet north of the shaft a winze has been put through to the second level stope. At the second level 200 feet in depth, the drifts north and south are 100 feet and 180 feet in length. The north stope has been carried through to the first level, while south of the shaft stoping is being done. On the third level at a depth of 300 feet, drifts have run north and south 80 feet and 50 feet respectively. No stoping has been done on this level.



Stamp mill, Grace gold mine.

The 10-stamp mill was run steadily throughout the year. The mill is driven by a 50-h.p. electric motor, the air compressor, developing 545 cubic feet of free air per minute, by a 100-h.p. motor, and the hoist by a 50-h.p. motor with type 167-B Westinghouse controller. From 20 to 25 tons of ore per day are being milled.

### Golden Reed Claims

The Golden Reed Mining Company have acquired mining claims Nos. 1239, 173, 174 and 175. Mr. M. Gates of Sault Ste. Marie, Michigan, is president of the company, and Mr. F. M. Dale, secretary-treasurer and manager.

The shaft on claim 1239 is 46 feet deep on an incline of 60 degrees. It was sunk at the junction of two veins, one running north of east, the other at right angles to it. The mill is erected a short distance from the shaft and the ore is hoisted direct from the shaft into the mill. A crusher, Huntingdon mill and plates have been put in

the mill and a couple of tests made. The company claim to be waiting for electrical power to operate mill, and negotiations have been opened for obtaining it from the Algoma Power Company. Some work was being done on another discovery or claim No. 133, where some quartz showing free gold was seen.

#### Blueberry Claims

About two miles south of the Golden Reed and just east of the road, Mr. John Flynn is prospecting for Mr. A. H. Boyce of Minneapolis. Work was being done in a couple of places on the claim, consisting of stripping and sinking test pits.

#### Norwalk Mine

This property was formerly known as the Manxman, and is last described in the Eleventh Report of the Bureau of Mines. It has been taken over by the Norwalk Min-

Golden Reed stamp mill.

ing Company, of which Dr. W. E. Gill is president and Mr. Samuel Moore, general manager.

The shaft has been sunk on the vein, which dips at an angle of 45 degrees and has an east and west strike, to a depth of 138 feet, with a level at 110 feet, where drifts have been run east 25 feet and west 25 feet. Electric power is obtained from the Algoma Power Company at High Falls and a 50-h.p. motor has been installed to drive the air compressor. A new 6-inch by 8-inch hoist has been put in and the 40-h.p. return tubular boiler is kept in reserve.

#### Algoma Power Company

This company have installed a power plant at High Falls on the Michipicoten river, about 10 miles from the Mission. The effective head of water at the falls is 128 feet. The bulk head is fitted with opening for a 10-foot flume, but only a 7-foot wooden

Stamp mill, Norwalk gold mine.

flume has yet been constructed One unit has been installed, consisting of a 450-K.W. generator developing at 600 R.P.M. to 10,000 volts, at which voltage the current is transmitted to the mines. Two other units of the same size can be installed at the power house. The latter is built of concrete.

Mr. W. Chartrand is superintendent of the plant.

## III.—TEMISKAMING

### Cobalt and Vicinity

The centres of activity in this district in 1908 were Cobalt, South Lorrain, Elk Lake, Miller Lake and Gowganda. At the Cobalt mines the production nearly doubled that of 1907, there being 19,437,875 ounces of silver produced in 1908 compared with 10,023,311 ounces in 1907. This increased production demanded increased working forces at the mines. It was also augmented by the addition of several new shippers, of whom Crown Reserve was the largest. No attempt is made in this Report to describe all the claims on which work is being done, only the shipping mines and those propects on which considerable work has been done being mentioned. In the township of Lorrain and southeast Coleman work was begun on a number of prospects during the latter part of the year, but these have not been inspected as yet, as work on them consisted of trenching, sinking test pits, building camps, etc., rather than actual mining. Nearly all the production comes from the mines in the vicinity of Cobalt and Kerr lakes. At the mines and prospects in the Cobalt area proper there were employed on an average during 1908 from 3,500 to 4,000 men working above and below ground.

The number of accidents reported from the Cobalt mines in 1908 was 23, resulting in 21 men killed and 9 injured. The general subject of Mining Accidents is dealt with in another part of this Report.

At all the shipping mines power plants have been installed, consisting of boilers, compressors, electric light plants and hoists. The Taylor Hydraulic Compressed Air Company is developing a power at Ragged Chute on the Montreal river, with the object of supplying power to the mines of Cobalt. This power is developed in the form of compressed air by the Taylor system of air compression. Air at a pressure of from 80 to 100 pounds is to be piped to Cobalt, a distance of about 8 miles, where it will be sold to the mining companies at about 50 per cent. of the present cost of power. The power company expects to have the plant completed and air delivered to the mines at Cobalt some time during 1909. The Beach Bros. are developing the water power at Hound Chute on the Montreal river and the Mines Power Company the power at the mouth of the Metabitchewan river with the object of selling electric power to the mines and also to the towns of Cobalt and Haileybury. When power from these three companies gets into the camp, the working costs at the mines will be materially reduced. At present coal costs from \$5.50 to \$5.75 per ton f.o.b. Cobalt, a price which even with the best of plants makes the cost of power from \$100.00 to \$120.00 per h.p. per year.

The question of the concentration of the lower grade ores has become an important one in the camp. On the first of April, 1909, there were seven concentrating mills in operation, two of which were custom mills, and two other mills were in course of erection. The seven mills in operation treat about 400 tons of rock in 24 hours. With the completion of the O'Brien and Colonial mills now being constructed, and the additions to the mills that are at present in operation, it is expected that the tonnage treated per 24 hours will be from 900 to 1,000 tons.

In South Lorrain there was considerable prospecting in 1908. A few of the companies were engaged in mining work, but the majority devoted most of their energies to trenching and test-pitting. A shipment of ore was made from the Keeley mine early in 1908. The map of South Lorrain accompanying Mr. A. G. Burrows' report

in Part II. of this Report will show the location of the various properties. Several steam plants have been taken in and a gas producer plant has been installed at the Keeley mine.

#### Montreal River

In the Montreal River area, more particularly in the township of James and adjoining townships, very little active mining work was done until the latter part of the year, though considerable prospecting, trenching and test-pitting was done on the claims that had been staked. During the winter of 1908 active development work was begun on a number of properties in this area. Several plants consisting of boilers and compressors have been installed, besides a number of small boilers and hoists for development work.

In the Maple Mountain area, townships of Whitson and Van Nostrand, active work was carried on by the Canadian Ores, Limited, on the claims staked by the White Bros. Several other companies were also engaged in doing assessment work and prospecting their claims.

#### Miller, Everett and Gowganda

During the summer of 1908 discoveries of silver and cobalt ore were made in the vicinity of Miller and Everett lakes in the townships of Nicol and Haultain, causing a rush to this region. All the land in the vicinity of these lakes was staked and the prospectors drifted west to Gowganda lake, where a discovery of silver was made by the Mann Bros. just before the close of navigation. This caused another rush, and, as the winter set in shortly after the discoveries, the rush and boom have continued all winter. The land for miles away from the discoveries has been staked, the only requisite seemingly being that the rock shall be diabase, which formation appears to be the one in which the greater number of silver discoveries have been made in this area. Several properties have been sold by the original owners for a large sum; others on which no discoveries of importance have been made are changing owners in about the same way as real estate. In most instances no examination of the property is made by competent men; all that is required to make a claim saleable is that the rock shall be diabase and near some well known and well advertised claim. When one claim favorably situated is sold for a large sum, the price of the claims adjoining rises in consequence, not because valuable mineral has been found on them, but simply from the speculative enhancement of values.

During the first three months of 1909 several hundred thousand dollars were spent on supplies and haulage. Haulage of freight to Gowganda during the winter was by two routes, one by way of the Temiskaming and Northern Ontario railway to Charlton and thence by team to Elk Lake and Gowganda, the other by way of the Canadian Northern railway to Sellwood, thence by team to Gowganda, a distance of probably 65 miles. The cost of haulage to this new camp was excessive. Mining companies paid about the first price of their plant in getting it transported from the railway to their property. Several compressors, boilers and hoists have been taken to Miller lake and Gowganda and are being installed at the most important claims.

No extensive mining work has been done at either of the above places as yet, but it is to be expected that during the present year considerable development will take place. Numbers of prospectors are going into this section and the present year will see a steady exploration of the unprospected areas to the west and northwest of Gowganda. Prospectors should not overlook the conglomerate areas in their rush after the diabase, as 85 to 90 per cent. of the silver production from Cobalt has come from the conglomerate, and, although the majority of the veins in the Montreal river and Gowganda areas have been found in the diabase, there is still the possibility of discovering another productive area of conglomerate.

### Larder Lake

There was very little activity in mining at Larder lake during 1908. A large number of the claims that were staked during the boom were cancelled for non-compliance with the working conditions. Some of these have been taken up by other parties and are being prospected. Stamp mills have been erected at three different properties on the lake and have been run at intervals. No systematic development has yet been done on any of the properties. A great deal of money has been foolishly squandered by men in charge of the work who had little or no knowledge of mining.

When the public begin to realize that money haphazardly spent on claims is in the great majority of instances absolutely wasted and that only intelligent development work counts, we shall have taken a great step towards placing the mining industry on the sound and legitimate basis which is its due.

Following is a description of the principal mines in the Temiskaming District arranged alphabetically. The location of the mines can be seen by referring to the maps of the Cobalt area, South Lorrain, Montreal River and Gowganda, published by the Bureau of Mines. The amount of ore shipped and the dividends paid by the various mines is given on preceding pages of this Report.

## Cobalt Silver Mines

### Argentite

At the time of my inspection of this property on January 21st, 1909, it was being worked under lease from the Argentite Mining Company by W. J. White.

No. 1 shaft had been sunk to a depth of 125 feet. No. 2 shaft, about 700 feet west of No. 1, had been sunk to a depth of 25 feet and sinking was being continued. A diamond drill was also at work.

A 60-h.p. boiler, straight line compressor and hoist have been installed near No. 1 shaft.

Instructions were given to have the ladder way put in at once to the bottom of the shaft and to have the hoist way separated from the ladder way.

### Badger

Inspection was made of this mine on November 21st, 1908. At that time all work was confined to No. 6 shaft, which has been sunk to a depth of 200 feet. The first level is at a depth of 100 feet, where drifts have been run east 50 feet and west 75 feet. The station was being cut at the 200-foot level preparatory to drifting. A number of other shafts, described in the Sixteenth report of the Bureau of Mines, have been sunk on the property to test the veins.

During the winter of 1908 and 1909 a new power plant was installed, consisting of two 100-h.p. boilers, compressor and hoist. A new power house and camp buildings have also been erected.

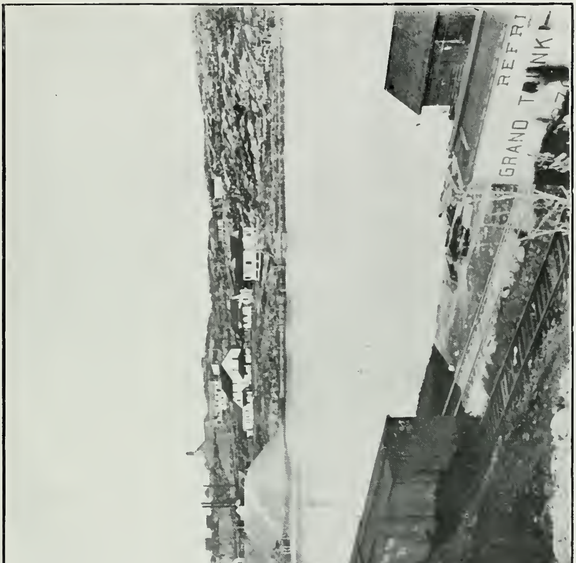
Instructions were given as to timbering the shaft and enforcing the law regarding men riding in the bucket.

Mr. A. A. Smith is manager for the owners, the Badger Mining Company.

### Beaver

This mine is owned by the Beaver Consolidated Mining Company, Mr. A. J. Hewitt being superintendent, and Mr. Robt. A. Bryce consulting engineer.

No. 1 shaft has been sunk to a depth of 200 feet and No. 2 shaft, 261 feet west of No. 1, to a depth of 75 feet. At the 75-foot level the two shafts have been connected by a cross-cut. From No. 1 shaft a cross-cut has been driven east about 300 feet and some drifting done on the calcite veins cut. On the 200-foot level a cross-cut has been



North end Cobalt lake, showing Right of Way, La Rose, O'Brien and Chambers-Ferland mines. Part of Cobalt town swept by fire, July 2, 1909, on left.

driven west 75 feet and east 325 feet, and a little drifting done. In April, 1909, the power house was destroyed by fire, but the work at the mine was continued, power being obtained from the Temiskaming mine, which adjoins the Beaver to the south.

### Bailey

This property was operated under lease in 1908 by the Standard Cobalt Mines, Limited, the operating company of the Cobalt Central mine.

On the first level an adit has been driven from the shaft a distance of 120 feet, and on the second level a drift from the shaft southeast on the vein 60 feet. From the latter drift a winze has been sunk a depth of 50 feet, and a little drifting done. On No. 2 vein a drift has been run from the Cobalt Central line northwest a distance of 250 feet.

The management was the same as that of the Standard Cobalt Mines, Limited.

### Buffalo

During last year all the underground workings at the Buffalo mine were connected. The ore is thus trammed underground to the main hoisting shaft No. 6, where it is raised to an overhead tram which leads into the concentrator. No work has been done on No. 6 vein first level since last Report, except breaking down some ore in the stopes. On the second level the drift has been driven east to connect with No. 5 shaft. A little ore has also been broken down in this stope. On No. 5 vein, first level, the drifts described in the last Report have been continued a short distance. Timbers have been put in and the ore is being broken down, only sufficient ore being drawn from the stopes to provide working room. On the second level of No. 5 vein the drifts have been driven on the vein corresponding with the drifts on the first level. Timbers have also been put in here, and some ore broken down. None of the stopes on this level have been carried up more than 20 feet. All the stoping done on the ore is by the overhand method. The main cross-cut from No. 6 shaft to No. 3 vein on the first level is 714 feet in length. At 406 feet from No. 6 vein a drift has been run east 225 feet on a small vein. On No. 3 vein the drift has been continued west a total distance from the cross-cut of 231 feet. From the east drift on the vein 167 feet from the cross-cut, a cross-cut has been driven north 46 feet to another vein having a strike east and west. A winze has been sunk just north of this vein to a depth of 75 feet and drifts run northwest 125 feet and east 60 feet. A cross-cut has been driven to No. 3 vein on this level and 170 feet of drifting done on it. The drift on the first level of the continuation of No. 4 vein east is driven to veins No. 10 and 11, which have been open cut to a depth of 25 feet. No. 12 shaft on the southeast corner of the claim has been sunk to a depth of 180 feet with levels at 80 feet and 140 feet respectively. On the first level drifts have been run on the vein northeast 175 feet and southwest 122 feet. At 73 feet from the shaft on this drift, short drifts have been run on off-shoots from the vein. Timbers have been put in preparatory to stoping, but very little ore has been broken down. On the second level drifts have been extended northeast 76 feet and southwest 50 feet. No stoping has yet been done on this level.

The main shaft house at No. 6 shaft has been raised to a height of 70 feet and the construction strengthened, so that the ore can be delivered at the top of the mill. The mill has been enlarged and the capacity increased, but the same system of concentration is used as that described in the last Report. The part of the mill for the cyanide treatment of the tailings is completed, but is not yet in operation.

A new stone boiler house has been erected with a battery of four boilers, two 100-h.p. and two 125-h.p. capacity.

Mr Tom R. Jones is general superintendent.

### Casey Cobalt

The Casey Cobalt Silver Mining Company, with Mr. James Rennie as manager, have been working continuously on their property, situated on the southeast quarter of the south half of lot 5 in the first concession of the township of Casey, about ten miles northeast of the town of New Liskeard.

The shaft has been sunk on the vein, which dips to the southeast at about an angle of 70 degrees, to the depth of 220 feet, with levels at 33 feet, 100 feet, 160 feet and 220 feet. The following drifts have been run on the first level, southwest 110 feet; on the second level, northeast and southwest 95 feet and 155 feet respectively, on the third level northeast 40 feet and southwest 120 feet. In the southwest drift a cross-cut has been driven north 30 feet. The shaft has been sunk in Huronian slate and conglomerate interbedded. A station and sump were being cut on the fourth level at the time of my inspection.

A power plant has been installed, consisting of two 40-h.p. boilers, a straight line compressor and hoist. A power house, office, shaft house and boarding camp have been erected.

Instructions were given to have the ladder way partitioned from the hoisting way, and landings put in

### City of Cobalt

Work has been going ahead steadily at this mine since last Report. The main shaft has been sunk to a depth of 210 feet and levels opened up here. The first level remains about the same as described, except that a long prospect drift has been driven from the shaft north 230 feet to the boundary of the Nancy Helen property, then east 210 feet, then north again a distance of 295 feet, the end of the drift being just north of the jail on Nickel street, the total length of the drift being 735 feet. On the second level much work has been done and a considerable tonnage of ore taken out. The east drift on the vein is 215 feet in length and the west 75 feet, which takes it to the Buffalo line. From the east drift a drift has been run southeast 65 feet, where another vein was found, on which 150 feet of drifting has been done. From the westerly end of this drift a cross-cut has been driven south along Galena street 230 feet and then east on lot 478 a distance of 75 feet.

On the third level at 200 feet in depth, the vein is found about 25 feet south of the shaft, and drifts have been run east and west 145 feet and 70 feet respectively, also southeast 65 feet to connect with the winze from the second level south vein. A winze is being sunk in the drift west from the shaft. It is the intention to sink this winze to the next level, drift to the shaft and raise it. Considerable stoping has been done on all the levels. All the stopes that have been worked lie under Miller avenue.

A new power plant was installed during 1908, consisting of two 125-h.p. return tubular boilers, 12-drill tandem compound compressor, and hoist. A new power house was also erected.

Mr. B. W. Leyson is manager for the company and W. J. Donaldson mine captain.

### Coniagas

Work was carried on continuously during 1908 at the Coniagas mine. The officers of the company remain the same with the addition of Mr. R. P. Rogers as assistant to president R. W. Leonard.

The underground work has been carried on, on both the 75-foot and 150-foot level. The mill has been changed and enlarged, so that it has a capacity at present of about 80 tons per 24 hours. Some stoping has been done, but the development work supplies the mill with a large amount of its tonnage.

The work on the first level of the mine was fully described in the last Report. During 1908 the work done consisted chiefly in extending the drift on the veins, cutting out the roofs of the drifts and putting in timber preparatory to stoping and breaking

down ore in the stope on the northerly veins on the property above the first level. The work on veins Nos. 8 and 9, the most southerly veins, has been carried on, about 260 feet of drifting being done on No. 8 and 200 feet on No. 9. On No. 9 veins a winze has also been sunk.

On the second level a drift has been driven west on the vein known now as No. 6 vein, formerly described as No. 3 vein, a distance of 210 feet and a raise put through to the first level in the vein. The vein continues east and southeast from the shaft, and has been drifted on for a distance of about 300 feet. A number of off-shoots from the main vein have also been tested. A cross-cut has been driven north to the No. 2 vein, a distance of 200 feet, and drifting on it to the east begun. There was a total of about 2,100 feet of drifting done in 1908.

The main shaft house on No. 6 vein is 85 feet in height, and the ore is hoisted in a self-dumping skip, which dumps into a shoot leading into the mill. The shaft is also equipped with pockets for filling the skip. A new hoist of increased capacity has been installed for the No. 2 shaft. This is placed in the engine house of the mill.

The concentrating mill has been remodelled by the installation of 30 stamps, doing away with the ball mill and Huntingdon mill for fine grinding. Additional tables have also been installed for handling the increased tonnage. A gas engine is used for driving the mill and electric light plant.

Mr. F. D. Reid is mill superintendent. A force of 125 men are daily employed at the company's works.

#### Cobalt Central

With the exception of diamond drill work on some of the outlying properties, the Standard Cobalt Mines, Limited, (the operating company of the Cobalt Central Mines Company), have confined their operation to their property on Glen lake.

The main shaft has been sunk to the third level at 180 feet in depth and a level driven from this. The first level remains about the same as formerly described, except that the stope on the No. 1 vein has been carried up about 50 feet for a length of 165 feet. On No. 2 veins stoping has also been done on this level west of the main drift for about 200 feet along the vein; part of this stope, however, is on the Bailey property. On the second level the main drift on No. 1 vein has been run to the No. 2 vein, a distance of 175 feet. On No. 2 vein, which is practically at right angles to No. 1 vein, an adit has been driven. This adit is 440 feet in length. West from this junction of veins Nos. 1 and 2, the vein has been followed 160 feet to the Bailey boundary. A considerable amount of stoping has been done on both Nos. 1 and 2 veins. On the third level, drifts have been driven to correspond very nearly with the drifts on the No. 1 and No. 2 veins on the second level. A drift has been driven on stringers from the No. 2 vein west 180 feet. At 80 feet from the shaft on the No. 1 vein a drift follows a stringer to the southwest 45 feet, where the diamond drill showed up some ore. A winze has been sunk from this drift to a depth of 75 feet and drifts driven east and west on the vein 50 feet and 40 feet respectively.

In sinking the winze from the third level, at a depth of 50 feet below the level, Huronian slate was encountered. This shows the diabase to have a thickness at this shaft of 230 feet. On the west side of Diabase Mountain the slate out-crops and is seen to have a dip to the east. The encountering of the slate at the Cobalt Central shows that the slate must dip quite uniformly to the east at about 14 feet per 100 feet. The vein has been found to be continuous from the diabase into the slate.

The capacity of the concentrating mill has been increased by the introduction of a tube mill for fine grinding, and of new screens and tables. The same scheme of concentration is in vogue as that described in the Sixteenth Report. The capacity of the mill is now about 80 tons per 24 hours. Some custom work has been done for the mines in the Kerr Lake area.

A new water tube boiler was installed during 1908.

Instructions were given regarding hoist and cage, and to have the ladder way boarded off from the hoist way in the shaft, and to maintain a ladder way in winze.

Mr. Jacob M. Young is superintendent, employing about 125 men.

### Chambers-Ferland

The Chambers-Ferland Mining Company, Limited, are working on that section of land surrounding La Rose Mine as shown on the Cobalt map.

No. 1 shaft has been sunk on the continuation of the No. 10 vein on La Rose. The first level of La Rose is an adit level. On the Chambers-Ferland the shaft is 90 feet in depth, and has been sunk on the vein on an angle of the claim between La Rose and the O'Brien. The drift is being driven on the vein 190 feet from La Rose boundary. The shaft is being sunk to the second level, it being now 50 feet

Crown Reserve silver mine, showing exposed bed of Kerr lake.

below the level. The stope on the vein has been carried up 35 to 40 feet. No. 2 shaft is situated south of La Rose and is 85 feet in depth. From this shaft drifts have been driven west 280 feet, south 215 feet, east 135 feet and north 70 feet.

Instructions were given at this shaft regarding thawing the dynamite and having ladder way lined from hoisting way.

Contract work is also being done from the Right of Way shaft by that company on the Chambers-Ferland property on what is supposed to be a continuation of La Rose main vein. Some drifting has been done on it and a raise is being put through to the surface to be used as a permanent shaft.

A new power house has been built and plant installed, consisting of boiler and compressor.

Mr. W. H. Jeffery is superintendent in charge, employing about 50 men.

### Crown Reserve

The Crown Reserve Mining Company have during 1908 been actively engaged in mining work, and have during the last six months been shipping regularly. The vein

Kerr lake, showing Drummond, Kerr Lake, Crown Reserve, Silver Leaf and Cobalt Central mines.

was first opened up by an open cut about 35 feet long near the Silver Leaf line. A main shaft has however been sunk off the vein to a depth of 100 feet, where a cross-cut of 25 feet was driven to the vein. Drifts have been driven from this cross-cut west on the vein 160 feet to the Silver Leaf line and east 100 feet to the Kerr Lake water claim J.B. 11. The shaft on the vein near the Silver Leaf line is being sunk to another level. Very little stoping had been done on the main vein at the time of my inspection. The cross-cut from the shaft has been continued north under the lake, a distance of 200 feet. At a distance of 170 feet from the shaft in this cross-cut, a prospect drift is being driven east, a distance of 140 feet having been attained. All the hoisting is now done through the main shaft.

The power plant consists of one 100-h.p. return tubular boiler, a 6-drill 2-stage compressor, hoist and electric light plant. A larger plant is to be installed during 1909.

The ore is roughly sorted underground, hoisted separately, and delivered into separate bins. The rock is put through a gyratory crusher and reduced to 2-inch size. This passes over a trommel which gives three products, under half inch, one-half inch to inch, and over-size. The fines are sacked, the middlings one-half inch to one inch are jigged, and the oversize passes over a travelling picking belt, where the ore is picked out by hand.

Mr. S. Cohen is manager of the mine, employing about 125 men.

Instructions were given to have the power magazine moved to a location conforming with the requirements of the Mining Act.

#### Coleman Development

The Coleman Development and Calumet Mining Companies have been amalgamated under the name of the Pan-Silver Mining Company, Limited. This company controls the south half of the north half of lot 2 in the third concession of Coleman. No. 1 shaft, sunk on the Calumet property to a depth of 100 feet, has been connected on this level with the No. 2 shaft on the Coleman Development property 230 feet northwest. From the No. 1 shaft a drift has been run south 120 feet and from the No. 2 shaft north 310 feet. Some 100 feet of drifting has been done on stringers encountered in the main drift. Another shaft has been sunk on the east shore of Brady lake to a depth of 100 feet and some drifting done.

Instructions were given as to timbering the shafts and putting in proper ladder ways.

A straight line compressor, 80-h.p. boiler and hoist have been installed.

Mr. Norman R. Fisher is manager and Mr. M. McCallum superintendent.

#### Columbus

Prospecting work was carried on continuously at this mine by the Columbus Cobalt Silver Company, Limited, during 1908. The main shaft has been sunk to a depth of 240 feet. On the first level at 75 feet a cross-cut has been driven east 30 feet and drifts run north 150 feet and south 40 feet. On the second level at a depth of 150 feet a cross-cut has been driven east 100 feet and drifts driven north 150 feet and south 75 feet. The station has been cut at the 240-foot level.

The mine was handicapped in 1908 by having its power house and camp buildings burned. New buildings were, however, at once erected and power plant, consisting of a 100-h.p. tubular boiler, a 5-drill straight line compressor and hoist, was installed.

Instructions were given to have the ladder way put in good condition, and to prohibit men riding in the bucket.

Mr. Wm. Shovells is superintendent, employing a force of 20 men.

### Cobalt Lake

The work of prospecting under Cobalt lake was continued throughout 1908 by the Cobalt Lake Mining Company.

The north or No. 1 shaft was deepened to 140 feet, and a level run at 127 feet. The work on this level consisted of an easterly drift to the boundary at the end of the lake of 92 feet, a westerly drift down the shore of 141 feet, and a northerly drift toward the other side of the lake 383 feet.

Work was continued on the first level of No. 4 shaft. The north cross-cut was extended to a distance of 733 feet and the south cross-cut to a distance of 909 feet. The drift on the No. 3 vein was extended west 118 feet and considerable stoping done.

No. 4 shaft was deepened to 162 feet, with a second level at 154 feet, on which a cross-cut was made to the north 123 feet. A drift was run toward the west shore of the lake 448 feet. A raise was put on No. 3 vein from the second level to meet a winze from the first level on the No. 3 vein.

No. 6 shaft was deepened to 143 feet, with a level at 133 feet, on which drifts were run 267 feet to the east and 414 feet to the west along the McKinley-Darragh boundary.

Shaft houses have been erected at No. 1, No. 4 and No. 6 shafts and hoists installed. All pumps and hoists are operated by compressed air.

Mr. D. B. Rochester is managing director, and Mr. E. L. Fraleck, superintendent An average force of 60 men is employed.

### Cobalt Town Site

No work was being done in the No. 1 shaft of this mine at the date of my inspection. Two shafts have been sunk on the north side of the property near the Buffalo mine 125 feet apart. The easterly shaft is 100 feet deep, and has a drift west 75 feet and east 75 feet. A drift was being driven south 25 feet on the vein from the west drift. The shaft 125 feet west is 65 feet in depth. Drifts have been run east to the easterly shaft and west 75 feet. On a cross vein between the shafts some stoping has been done.

The power plant near No. 1 shaft furnishes air for the operation of the drill and hoist.

Instructions were given regarding guard rails and ladder way.

Mr. B. W. Leyson is manager.

### Colonial

Mining work was carried on at intervals during the year, but the mine was not in operation at the time of my inspection on January 23rd, 1909. At that time, however, the foundation was being prepared for a concentrator.

Mr. G. W. McCaskell is in charge of operations.

### Century

The Century Silver Mining Company is working on the east half of the northeast half of the north half of lot 1 in the sixth concession of Coleman. A shaft has been sunk to a depth of 165 feet.

Instructions were given to have shaft timbered before further sinking was done.

Power was furnished by small upright boiler and hoist.

Mr. E. R. Mohr is superintendent.

### Canuck

On the southwest quarter of the south half of lot 13 in the second concession of Bucke, the Canuck Silver Mines Cobalt, Limited, have sunk a shaft 100 feet in depth and have begun to drift. No more work was allowed to be done until shaft was timbered and new cable procured.

Mr. D. K. Martin is manager for the company.

### Drummond

All work underground at this mine had ceased at the date of my inspection with the exception of work at one cross-cut, which was being driven southwest from the first level, 200 feet having then been driven from the shaft. The mine was full of water to the first level. During the year the main workings were connected with No. 2 shaft, a distance of 300 feet, and on the second level a drift was driven north under the lake. Considerable diamond drilling was being done on the property.

Mr R. W. Brigstocke is manager.

### Davis Fraction

On the fraction west of the Rothschild and adjoining the Gillies Limit, Mr. H. P. Davis and associates have been prospecting and sinking test pits. One shaft has been sunk to a depth of 85 feet. Instructions were given as to timbering the shaft and strengthening the derrick.

Mr L. H. Barthe is in charge of the work.

### Floyd

The Floyd Silver Mining Company, Limited, with Mr. Algernon P. Seymour as manager, have been opening up a prospect on the northwest quarter of the south-half of lot 1 in the second concession of Bucke. A shaft has been sunk 115 feet with the first level at 46 feet. On this level drifts have been driven west 40 feet and east 20 feet.

A 10-h.p. boiler and small hoist have been installed.

Instructions were given as to timbering the shaft and the building of a proper magazine.

### Farah

During the latter part of the year considerable diamond drilling was done on this property, which is situated on the northeast quarter of the south-half of lot 3, in the fifth concession of Coleman. Surface prospecting work was also carried on. Camp buildings have been erected and preparations made for beginning mining at once.

Mr. Alex. H. Smith has recently been appointed manager.

### Foster

All the work at the mine is now being carried on through No. 5 shaft. This shaft is 210 feet deep, with levels at 70 feet, 140 feet and 210 feet. On the third level drifts are being run north to follow the vein under Glen lake, and south towards No. 6 vein. A little drifting is also being done on the cross vein encountered south of the shaft. On the second level drifts have been driven north on the main vein and south to No. 6 vein. A drift is now being run on this vein On the first level the work is about as formerly described, except that a winze has been sunk to the second level from the vein south of the shaft. Connection has been made on this level between No. 5 and No. 6 shafts. Considerable stoping has been done on these upper levels. During the summer a shaft was sunk 40 feet deep on the discovery vein near the shore of Glen lake.

Mr. J. McDonald is superintendent in charge.

### Green-Meehan

The Green-Meehan and Red Rock mines have been amalgamated under the name of the Consolidated Silver Cobalt Mines, Limited. At the date of my inspection, December 10th, 1908, the Red Rock mine was not in operation. At the Green-Meehan the main shaft was found to be 100 feet deep. Drifts have been driven north 125 feet

and south 175 feet and 75 feet of cross-cutting done. The other shafts on the property were not pumped out.

Two 100-h.p. boilers have been installed, and a straight line compressor.

Instructions were given as to riding in bucket and guarding the shaft.

Mr. Geo. Leyson was superintendent in charge, employing a force of 25 men.

### Gould Consolidated

The Gould Consolidated Mines Company have obtained a lease on the south end of Cart lake. Two shafts have been sunk on the east shore of the lake about 400 feet apart, 65 feet and 80 feet deep respectively. From the deeper shaft drifts have been begun at the 75-foot level. It is the intention of the company to connect the shafts

Foster Cobalt silver mine.

underground, and also to drive out under the lake. Work at the shafts has been done chiefly by contract, air being obtained from the Nipissing mine.

Instructions were given to have the shafts properly timbered.

### Hargrave

Work was resumed on this property by the Hargrave Silver Mines, Ltd., in the latter part of 1908 after having been closed for a couple of years. Settlement between the company and the Crown was effected by the company agreeing to pay a royalty on the output.

A shaft had been sunk to a depth of 100 feet and a cross-cut driven to the vein 45 feet. About 20 feet of drifting had been done on the vein. The company at present are sinking the shaft, it being their intention to sink to at least the 300-foot level before cross-cutting to the vein. Air for the drills and hoist is obtained from the Drummond mine.

Mr. E. V. Neelands is manager for the company.

### Kerr Lake

Work was carried on continuously during 1908. The shaft on No. 3 vein has been sunk to the fifth level, a depth of 320 feet. The work done on this vein above the third level was described in the last Report of the Bureau of Mines. During 1908 the drift on the third level south was extended to a distance of 225 feet and 140 feet north. Considerable stoping has been done on this level. On the fourth level at a depth of 240 feet drifts have been driven north 60 feet and south 190 feet. A winze was first sunk 110 feet south of the shaft on the vein and a drift driven to the shaft, station cut and shaft raised. On this level stoping is also being done. On the fifth level the winze has been sunk from the fourth level a depth of 60 feet and drifts driven south 90 feet and north 110 feet to the shaft. The shaft was being raised at the time of my inspection. No stoping has been done on this level. On the second level 85 feet south of the shaft a cross-cut has been driven west 360 feet and on the same level 90 feet north a cross-cut driven northwest 320 feet.

All the work on the north side of the property is carried on through No. 7 shaft. This shaft has been sunk to a depth of 200 feet. The work during 1908 was confined chiefly to the second and third levels. The second level at a depth of 140 feet has drifts run south 580 feet and north 180 feet. Cross-cuts have been driven from the shaft west 240 feet and east 420 feet to connect with vein No. 9. On this vein 80 feet of drifting has been done on this level, and a cross-cut driven south from it 80 feet. On the No. 7 vein on this level considerable stoping has been done. On the third level at a depth of 200 feet a drift has been driven south 120 feet and north 340 feet. This north drift is mostly under the lake. A drift has been started on a stringer from this main drift west towards the Crown Reserve vein. Some stoping has also been done on this level.

A shaft called the Railroad shaft has been sunk near the Kerr Lake branch to a depth of 83 feet. Drifts have here been driven south 75 feet and east 50 feet.

New thawing houses and magazine have been built.

Mr. S. R. Heakes is manager, employing a force of 100 men.

### Kerr Lake Majestic

The Kerr Lake Majestic Silver Mining Company began operations on the east half of the south east quarter of lot 3 in the fifth concession of Coleman in January, 1909. A power plant consisting of two 125-h.p. return tubular boilers, a 12-drill tandem compound compressor and hoist have been installed. A shaft has been sunk to a depth of 75 feet.

Mr. Wm. Powell is managing director, and Geo. Young, superintendent.

### Kerry Lease

The Kerry Mining Company have obtained a lease on the northern part of Cart lake and a lease on 20 acres of Peterson lake, south of the Little Nipissing lease. On the Cart lake lease a shaft has been sunk to a depth of 85 feet and drifting begun on the west shore of the lake near vein 86 on the Nipissing. A shaft house has been built and two upright boilers and 3-drill straight line compressor installed. Camp buildings have also been erected on the west shore of the lake.

On the Peterson lake lease a shaft has been sunk to a depth of 65 feet and head frame erected. Air for the drill and hoist is obtained from the Nipissing Company.

Mr. Herbert E. Jackman is manager for the company.

### King Edward

Work was done by the King Edward Silver Mines, Limited, in 1908, on both the Watts and King Cobalt properties. The general plan of development work outlined in the last Report has been followed during the year, the drifts on the main veins

having been extended and the stopes put in shape for getting out the ore quickly and cheaply. A cross-cut has been driven west from the No. 1 shaft, a distance of 190 feet. From the end of the main adit some diamond drilling has been done, to test the veins that have been located on the surface on the western side of the lot. Two shafts have been sunk on veins on the western side of the claim to a depth respectively of 50 feet and 80 feet. From the deeper shaft drifts have been extended 100 feet north and south.

On the King Cobalt location, No. 6 shaft has been sunk 50 feet, and an adit driven from the face of the cliff to the shaft 50 feet, where drifts have been run on the vein north 100 feet and south 110 feet. No. 4 adit south of No. 6 has been driven 110 feet west. No. 2 adit south of No. 4 has been driven west 230 feet. A drift 75 feet in length has been run north from this adit.

A 10-stamp mill has been constructed on the Watts property just south of the mouth of the main adit. The ore is first fed to a gyratory crusher which reduces it to an inch or inch and a half product. From this it is fed to the stamps. The pulp from the stamps passes to a classifier, the sands from the classifier to two James tables, and the overflow from the classifier to a Frue vanner.

Instructions regarding ladder way in shafts and the storage of dynamite were given.

Mr. Glenn Anderson has been appointed manager

### La Rose

This mine is now owned by La Rose Consolidated Mines, Limited, who also own or control the Lawson, Princess, Eplett, Fisher, Silver Hill, University and Violet. These other properties will be taken up on other pages of this Report. No work was done, however, on the Eplett, Fisher and Silver Hill during the year.

La Rose mine during the last six months of 1908 shipped a large tonnage of ore, being one of the largest shippers in the camp.

The main levels of the mine are at approximately 80 feet, 175 feet and 255 feet. Intermediate levels have been run at 50 feet and 100 feet, and on these a great amount of the stoping has been done. The 50-foot intermediate level has been extended north 175 feet from within a few feet of the shaft. Access to it is obtained through a raise north of the shaft. This 50-foot level south extends from within a few feet of the shaft to the Right of Way line. Entrance to this level is through the old discovery shaft. On the No. 3 vein the 50-foot level has been extended from the main vein 165 feet east. On the same vein 300 feet from the main vein a raise has been put up 30 feet and a stope carried along it for 120 feet.

On the 80-foot level the main drift north has been extended 50 feet to a total distance from the shaft of 570 feet. At a point 320 feet north of the shaft on the main drift, a drift has been driven east 310 feet on what appears to be the No. 10 vein.

South of the shaft on this level from the junction of the main vein with the Right of Way line, a drift has been extended south 340 feet. Some stoping has been done on the main vein on this level, but the greater part has been done on the sub-levels.

On the 100-foot level from a winze sunk north of the shaft a drift has been extended north 640 feet. Considerable stoping has been done between the shaft and winze which is 100 feet north of the main shaft. South of the shaft stoping has also been carried on at this level from within a few feet of the shaft to the south limit of the vein.

On the 175-foot level, the north drift has been extended 450 feet north of the shaft.

On No. 3 vein 150 feet from the south boundary of the claim a shaft has been sunk 50 feet below the adit level. Just north of the No. 3 adit level another adit has been run 300 feet east.

The adit on No. 10 vein has been extended to the Chambers-Ferland line, a distance of about 300 feet. The vein is being stoped ont to the surface. The adit north of No. 10 has been driven east 160 feet.

Bumping tables have been put in at the main shaft and No. 10 vein, on which to pick the ore.

No change has been made in the power plant except the installation of a new hoist.

Mr. R. B. Watson is general manager, and Mr. T. J. Harwood superintendent.

#### Little Nipissing

The Little Nipissing Silver Cobalt Mining Company, Limited, was working on mining location J.B. 2, immediately south of the Princess mine, during 1908. An adit has been driven east from the shore of Short lake, a distance of 205 feet. A discovery was made during the year on the west shore of the lake by the diamond drill, and a shaft has been sunk on the discovery to a depth of 50 feet.

Instructions were given as to the timbering of the shaft and the derrick construction.

Mr. S. D. Maddin is in charge of operations.

#### Litttle Nipissing Lease

The Little Nipissing Silver Cobalt Mining Company have taken a lease of 20 acres on the west shore of Peterson lake. The shaft has been sunk to a depth of 150 feet with the first level at 100 feet. On this level a drift has been driven northeast on the vein 175 feet. At a point 60 feet from the shaft a cross vein was encountered and a drift driven on it 75 feet. From the shaft drifts have been extended south 100 feet and northwest 60 feet. The second level is at a depth of 150 feet. No drifting had been done here at the time of my inspection.

The machinery consists of a reversible link motion hoist. Power is obtained from the Nipissing mine.

An interesting geological occurrenee was noted, occurring in the drift on the cross vein from the main vein. While driving east a dark basic rock was encountered about 35 feet east of the main vein. This rock is apparently a diko rock showing biotite and hornblende, probably a mica hornblende lamprophyre. The dike shows to be at least 12 feet wide, though the width has not been fully determined. The vein, which was in Keewatin when found, passed into the dike and, although somewhat broken in the dike, still carries silver values in places. This proves that the vein filling was subsequent to the intrusion of the dike.

Instructions were given to discontinue hoisting ore or rock from first level while sinking was in progress, and to build a proper magazine and thawing house.

Mr. S. D. Maddin is manager and Mr. L. Church mine captain.

#### McKinley-Darragh

This mine was a steady shipper during 1908. The ore is now all hoisted through No. 1 shaft, as it is connected by tramway with the concentrating mill. On the 90-foot level of No. 1 shaft about 600 feet of drifting and cross-cutting have been done to the southwest of the shaft. On the 155-foot level No. 1 shaft has been connected with No. 2 by a cross-cut 400 feet long Immediately east of No. 1 shaft a drift has been extended north 350 feet, about 200 feet being under Cobalt lake. On the main cross-cut, 140 feet west of No. 1 shaft, 180 feet of drifting has been done north of the cross-cut. From this drift a winze has been sunk 55 feet and 200 feet of drifting done on the vein at that level. At a point in the cross-cut, 260 feet from No. 1 shaft, a vein was encountered on which drifts have been driven south 220 feet and north 170 feet. This vein has been broken down for about 12 feet in height and timbers have been put in for stoping. In the north drift a winze has been sunk to the 210-foot

level and about 200 feet of drifting done at this level. From No. 2 shaft drifts have been driven south 330 feet and north 389 feet. In this north drift 80 feet from the shaft drifts have been run west 375 feet and east 200 feet, where a connection is made with drift from central vein. Considerable drifting has been done on the 60-foot and 110-foot levels of No. 2 shaft.

No. 3 shaft near the east boundary of the claim has been sunk 50 feet and 100 feet of drifting done.

No. 7 shaft, which adjoins the Kendall vein on the Nipissing, is 115 feet in depth, with levels at 70 feet and 115 feet. On the 70-foot level about 250 feet of drifting have been done on the vein and on the 115-foot level 110 feet.

A cage is used in No. 1 shaft having a counterbalance.

McKinley-Darragh silver mine, Cobalt lake in foreground.

Instructions were given regarding the ladder ways in the winze and men riding on the cage.

The concentrating mill has been erected to the south of No. 1 shaft and across the railway track. The ore is first fed to a jaw crusher which is placed near the base of the mill and then elevated by bucket elevator and belt conveyor to a trommel, from which it goes to the jigs. The tailings from the jigs are fed to the 20-stamp mill. The product from the stamps passes to a classifier and then to Wilfley tables and Frue vanners. The tailings from the tables and vanners are then reground in a tube mill. The product from the tube mill is treated on Deister slime tables from which the tailings run to waste.

Power for the mill is supplied by two 100-h.p. boilers and a 150-h.p. engine.

Mr. P. A. Robbins is general manager for the company, employing about 125 men.

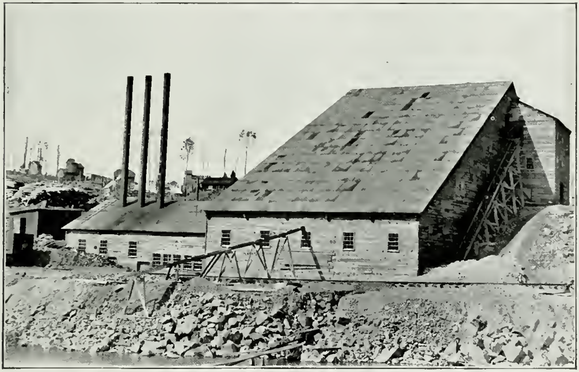
#### Red Jacket (Morrison)

This property, situated on the northwest part of the north-half of lot 7 in the fourth concession of Coleman, has been purchased from the original owners by a group of interests represented by Mr. B. E. Cartwright. A plant has been installed at the property and a shaft is being sunk, a depth of 60 feet having been attained. Camp buildings have been erected.

Mr. T. Fee is in charge of operations, employing a force of 25 men.

#### Northern Customs Concentrator

This concentrator was formerly known as the Muggley concentrator. It is now owned by the Northern Customs Concentrator, Limited, with Mr. F. J. Borne, manager. It is a custom mill and has been operated continuously during the year. The capacity of the mill is being increased by the addition of 30 stamps, making a total of 50 stamps in the mill and 2 Nissen stamps.



Northern Customs Concentrator, Cobalt.

#### Nancy Helen Mine

The main shaft at the Nancy Helen mine has been sunk to a depth of 190 feet. On the first level at 100 feet drifts have been run north 200 feet, east 80 feet and southeast 25 feet. A productive vein was encountered on a drift off the north drift and 75 feet from it. About 135 feet of drifting has been done on this vein and also some stoping. A winze 10 feet in depth was sunk on it. On the 175-foot level a station has been cut and drifting begun.

Instructions were given regarding the position of boiler and the necessity for an auxiliary exit.

Mr. J. W. Prout was manager, employing a force of 25 men.

#### Nipissing

The Nipissing Mining Company were operating eight different shafts at the date of my inspection, November 27th, 1908. During the summer, a number of other shafts were also worked, and a large amount of trenching and test-pitting done. About

half the company's mining work at present has, however, shifted from the east side of Cobalt lake, on R.L. 404 and 406, to the property north of the town of Cobalt on R.L. 400. In this section four shafts are being worked. These are the Meyer, Fourth of July, Promise and No. 64.

The Fourth of July, or No. 80 shaft is sunk on a vein just east of the Coniagas boundary, to the depth of 75 feet. On this level drifts have been run south 100 feet and north 150 feet. The shaft at the time of inspection was being sunk to the 150-foot level. A shaft house has been erected and ore house with picking table. Air for the drills and hoist at all the shafts is obtained from the power plants on the east side of the lake.

The Meyer or No. 73 shaft is 600 feet north of the Fourth of July, and east of the Trethewey. On the 75-foot level drifts have been driven on the vein 150 feet east and 200 feet west, and some stoping done. A cross-cut has been started south from the shaft to connect with the Fourth of July shaft. About 250 feet have already been driven. This shaft is also being sunk to the 150-foot level. Hoisting from this shaft was by means of hoist and derrick.

Instructions were given to put in pentice while sinking was being done, or cease all work on the first level.

The Promise shaft has been sunk west of the Right of Way shaft to a depth of 100 feet as a prospect shaft only, no vein having been found. The rock was here covered with about 40 feet of soil and gravel. From the level drifts have been driven north 200 feet, and west and south 50 feet and 90 feet respectively.

Shaft No. 64 was sunk 130 feet east of the Temiskaming and Hudson Bay mine to a depth of 75 feet. On this level drifts have been run east 130 feet and west 60 feet. From this west drift a cross-cut has been run north 80 feet. Since my inspection of this shaft it has been sunk to the 150-foot level and a station cut. While cutting the station a vein rich in silver of good width was struck.

Instructions were given regarding hoisting equipment and the thawing of dynamite.

To the east of Cobalt lake the Kendall vein has proved a large producer. The work on the first level was described in the last Report of the Bureau of Mines. The shaft is now 150 feet in depth. On this level two drifts have been extended west, about 70 feet apart, a distance of 200 feet and east 300 feet, where a vein was encountered striking at an angle of about 30 degrees to the main vein. On this 175 feet of drifting has been done. A raise has been put through to the surface from this east drift. From the station on the first level a cross-cut is being driven south under what is known as the valley of the "little silver" vein. It has now been extended 450 feet. A new ore house has been constructed 100 feet east of the main shaft house, and picking tables put in.

South of the Kendall shaft considerable work was done during the summer on vein No. 96. An adit was driven east into the bluff 260 feet. At 100 feet from the mouth of the adit, drifts have been driven on the vein 125 feet north and 140 feet south.

Veins 86 and 87 on the east shore of Cart lake were worked during the summer of 1908. On vein 86 a shaft was sunk to a depth of 75 feet and a drift run on the vein 220 feet southwest. From this level a cross-cut was driven 120 feet northwest to vein 87, where 100 feet of drifting was done.

Work on vein 49 has been confined chiefly to taking out ore from the open cut and exploring on the first level. The adit on vein 28 from the shore of Cobalt lake has been connected up with the first level of this shaft. Shaft No. 25 to the northeast has also been connected on this level by a drift 560 feet in length. In addition to this a cross-cut has been driven south from the shaft 190 feet, and a drift driven east 440 feet on stringers from the vein. A winze has been sunk from the open cut on vein No. 49 to the 100-foot level 300 feet east of the shaft.

The shaft on veins No. 10 and 26 has been sunk to a depth of 210 feet, with levels at 50 feet (the level of the open cut), 110 feet and 210 feet. The shaft is sunk on what was known as vein No. 10, and cross-cuts driven to vein No. 26 from the different levels a distance of 65 feet. On the three levels the vein has been drifted on for about 250 feet, with short drifts or stringers from the main vein. The levels have been connected by raises and considerable stoping done. On the open cut level a cross-cut has been driven west about 500 feet.

Instructions were given regarding the thawing house.

On vein No. 81 on the shore of Cobalt lake a shaft has been sunk to a depth of 75 feet and 125 feet of drifting was done.

No work was being done at shaft No. 12 at the time of my inspection. This was worked, however, during the summer of 1908. The west drift from the first level was extended under the workings of vein No. 15, a distance of 175 feet, and vein No. 52, a further distance of 150 feet.

Nova Scotia silver mine.

The power plant remains the same except that another 100-h.p. boiler was added to the plant near the Kendall vein. The Kerr lake branch of the T. & N. O. railway runs near the Kendall shaft and power house, and all ore is loaded and coal unloaded here. The air from the plant here and from the Peterson lake plant is piped over the property to the several workings. The ore is all brought to the sampling plant on the shore of Cobalt lake, where it is crushed and sampled before shipping.

Mr. R. B. Watson is general manager of the company, and Mr. Hugh Park is manager, employing during the winter months about 200 men and in the summer 300 to 400 men.

#### Nova Scotia

The Nova Scotia Mining Company have made their No. 3 shaft near Peterson lake their main working shaft, and have erected a large shaft house and sorting tables here. The work done on the first, second and third levels was described in the last Report. The work done on these levels during the last year consisted chiefly of stoping and driving east on the second level and of cross-cutting. On the fourth level the vein

was cut 25 feet south of the shaft. From here drifts have been extended east 125 feet and west 320 feet. Part of this westerly drift is under Peterson lake. Considerable stoping has been done on this level. On the fifth level cross-cuts have been driven north from the shaft 115 feet and south 50 feet. Drifts have been extended east from the south cross-cut 90 feet and west 325 feet. A winze was sunk on the west drift from the fourth to the fifth level and stoping has been begun. Preparations were in progress to sink a winze from the fifth level in the west drift.

Instructions were given regarding the winzes and also with respect to a new thawing house.

New camp buildings have been erected during the year.

Mr. A. M. Bilsky is managing director, and Mr. Rex Taylor is superintendent.

#### Nugget Claim

This claim has been leased by Mr. A. M. Bilsky and is being worked by him. A shaft has been sunk to a depth of 100 feet and a drift run north 60 feet. North of this shaft an adit has been driven 200 feet east into the bluff. A shaft is also being sunk on island No. 22 on Giroux lake. This shaft is now 40 feet deep. Air for two drills and a hoist is obtained from the University mine.

Instructions were given regarding the ladder way and men riding in the bucket.

#### O'Brien Mine

The owners of this mine are the same as at last inspection. Mining work was prosecuted vigorously throughout the year. At No. 1 shaft most of the work has been done on the 200-foot level. On the 50-foot level little work was done in development, but considerable stoping was done both east and west of the shaft. The east drift on the 100-foot level has been extended to a distance of 650 feet from the shaft. Some drifting and cross-cutting was also done west of the shaft. On the 200-foot level the drift east has been extended to a distance of 900 feet from the shaft. It is the purpose of the management to connect this drift with the No. 6 workings. In this drift, 450 feet from the shaft, a raise has been put through to the 100-foot level. No additional work has been done on the 300-foot level.

Instructions were given at this shaft to maintain an auxiliary exit from all the working levels.

No. 2 shaft has been sunk 175 feet, with first level at 65 feet and second level at 165 feet. On the first level a drift east has been driven 250 feet and west 150 feet, then south 160 feet. From a point 50 feet east of the shaft a drift has been driven south 200 feet. Stoping has been begun in this drift.

On the second level drifts have been run south from the shaft 190 feet, southeast 150 and north 80 feet.

Instructions were given to have the ladder-way partitioned from the shaft, to place guard rails at the various levels and to make an auxiliary exit from the mine.

No. 6 shaft is now a depth of 260 feet. On the first level the east drift is 325 feet in length and the west drift 350 feet. Stoping has been begun from both drifts. On the second level the east drift has been extended 275 feet from the shaft and the west drift 300 feet. A raise is being put through from the west drift to the first level. On the third level drifts have been run southeast 125 feet, east 225 feet and west 150 feet. This shaft was started in diabase and sunk through it to near the third level, where Keewatin was encountered.

Instructions were given at this shaft regarding an auxiliary exit and the thawing house.

No. 16 shaft, northeast of No. 6 shaft, has been sunk 75 feet and drifts are being run northeast and southwest. The southwest drift is intended to connect with the first level of No. 6 shaft.

Instructions were given here as to putting the shaft in proper condition.

Another shaft was sunk during the year north of No. 6 to a depth of 75 feet.

A 30-stamp concentrating mill is being erected on the property. It is proposed to concentrate by means of jigs and tables and also to treat part of the ore by cyanidation.

Mr. M. T. Culbert is manager, employing a force of about 150 men.

### Ore Reduction Company

This company first installed a dry process of concentration throughout. It was operated for a time, but did not prove a success. A partly dry and partly wet method was then tried. This was also unsatisfactory. It was therefore decided to instal a wet process throughout. This change was decided on during the first part of 1909. The ore is now crushed by two 6x10-inch jaw-crushers, six sets of rolls and a Hardinge mill. The concentrating end of the mill consists of four double compartment jigs, two Wilfley tables, seven James tables and a James slimer. The mill is expected by the management to have a capacity of 80 tons per day.

### Peterson Lake

The Peterson Lake Mining Company have adopted the leasing system for the beds of Peterson and Cart lakes. The lake has been divided up into 20-acre lots and leased to a number of companies on a royalty basis. Among the lessees are the Nova Scotia Mining Company, Little Nipissing Mining Company, Kerry Mining Company, Gould Consolidated Mining Company, Union Pacific Mining Company, St. Anthony Mining Company, Brydge Syndicate, O. N. Scott and Cyril T. Young. Shipments have been made from Peterson lake ground by the Nova Scotia Mining Company and the Little Nipissing Mining Company.

### Provincial Mine

The Provincial mine on the Gillies Limit has been worked continuously during the year. Shipments of both cobalt and silver ore were made. On the first level drifts have been driven east and west on the main vein 350 feet and 250 feet respectively. In addition to this, 270 feet of drifting has been done on other vein cuts. East of the shaft a cross-cut has been driven south 200 feet. West of the shaft cross-cuts have been driven north 170 feet and south 175 feet. A raise has been put through to the surface and some stoping done. On the second level drifts have been run east of the shaft 310 feet and about 125 feet of cross-cutting done north and south of the vein. A raise has been put through from this to the first level. A shaft has been sunk on a vein near the Savage mine to a depth of 67 feet.

Mr. S. Hunter is superintendent in charge at the mine.

During the summer of 1908 considerable prospecting was done on the limit in the vicinity of Giroux lake. This work was under the supervision of Mr. James Bartlett.

### Princess

The Princess mine (J.B. 3) situated south of the McKinley-Darragh mine is owned by La Rose Consolidated Mines Company.

Mining work was carried on at the property during part of the year. The shaft has been sunk to a depth of 125 feet and drifting begun at the 50-foot level. About 330 feet of drifting and cross-cutting have been done.

A shaft and ore sorting house has been erected. Power for the drills is obtained from the Silver Queen mine.

Mr. James Adams is superintendent.

### Pontiac

The Pontiac Mining Company have commenced operations on the northeast quarter of the south half of lot 2 in the fifth concession of Coleman. Some trenching has been done and one shaft sunk to a depth of 45 feet.

Camp buildings have recently been erected and preparation made for carrying on mining work.

Mr. H. P. Davis is manager for the company.

#### Paterson

This property is situated on the east half of the northeast quarter of the south half of lot 2 in the third concession of Coleman.

A shaft has been sunk to a depth of 100 feet and drifts run north and south about 75 feet.

A small boiler and hoist have been installed at the property.

Instructions were given as to timbering the shaft and putting in ladderway.

#### Progress

At the time of my inspection of this property work was being done in the north shaft, which was 80 feet deep. At this level 180 feet of drifting and cross-cutting had been done. Instructions were given to board up the ladderway, and respecting the care of explosives and men riding in the bucket.

Diamond drilling on the property has since been done, and a shaft started towards the south end of the claim.

Mr. Jos. Herman is superintendent in charge.

#### Queen Alexandra

This property is situated on the east shore of Cross lake, directly across the lake from the Silver Cliff mine.

During the winter a shaft was sunk on the top of the bluff to a depth of 100 feet. Another shaft has been begun on a vein at the shore of the lake.

#### Right of Way

All the work done by the Right of Way Mining Company on the veins adjoining La Rose mine has been through the No. 2 shaft. On the first level the drift has been extended and connected up with No. 1 shaft. Three veins have been worked near this shaft, all being parallel and from 20 to 30 feet apart. Stoping has been done on all three of these veins above this level. A drift has been extended north from the north vein under the centre of the railway track, a distance of 400 feet. From the second level of No. 2 shaft a drift has been driven north about 600 feet. Raises have been put up to the first level on each of the veins worked on the first level. A little stoping has been done below the first level on the central vein. On the second level, near the main shaft, a sump has been cut and a steam pump installed.

On the first level cross-cut west to the Chambers-Ferland property, the Right of Way Company have done some drifting for the former company, and have started a raise to the surface for a working shaft.

No. 3 shaft of the Right of Way Company is situated just east of the Silver Queen and on the continuation of the latter's vein. The shaft is sunk 75 feet to the first level and a cross-cut driven 60 feet north to the vein. On the vein 100 feet of drifting has been done. A drift has been run from this level and connected with the Silver Queen workings on the first level. Drifts are also being driven north anad south under the right of way of the railway. A shaft and ore sorting house has been erected. Power was obtained from the Silver Queen mine.

Mr. Jos. Houston is manager of the company, and Mr. R. Sandow mine superintendent.

#### Rochester

Work was resumed at this property in 1908. On the first level at a depth of 75 feet drifts have been run east and west on the vein, 75 feet and 125 feet respectively. At the time of my inspection the shaft was being sunk to the 175-foot level.

Instructions were given regarding guard rails and proper thawing houses.

Mr. C. E. Beard is superintendent in charge.

### Savage

This property is owned and operated by the McKinley-Darragh-Savage Mines, Limited.

No. 1 shaft on the original discovery is 120 feet deep, with levels at 70 feet and 125 feet. On the 70-foot level 180 feet of drifting has been done east and west on the vein, and 175 feet of cross-cutting. On the 125-foot level the west drift is 150 feet in length, and cross-cuts from this have been run 95 feet north and 100 feet south.

No. 2 shaft, 400 feet west of No. 1 shaft, is 100 feet in depth, but no drifting has been done.

During the summer of 1908 a vein was discovered 500 feet southeast of No. 1 shaft. A shaft has been sunk on this vein 70 feet and 100 feet of drifting done on it.

This mine is under the same management as the McKinley-Darragh.

### Silver Bar

Work was done on this property during part of 1908. A controlling interest in the property was acquired during the latter part of the year by a number of Toronto men.

Cobalt Silver Queen mine, and No. 3 shaft of Right of Way Mining Company to the left.

The old workings have not been re-opened, but a new shaft has been begun about 205 feet north of the old shaft, and another on a vein west of the shaft. A diamond drill has also been at work on the property for some time.

Instructions were given regarding ladderway and thawing house.

Mr. N. Fisher is consulting engineer.

### Silver Queen

No sinking has been done on the main shaft of the Silver Queen in addition to that described in the last Report. The work has consisted chiefly in extending the levels east and west and in stoping. Both levels have been driven east to within a few feet of the Right of Way. The first level west drift has been extended about 450 feet from the shaft. A raise is being put through to the surface from this drift.

A new shaft has been sunk near the south side of the lot to a depth of 75 feet. No drifting had been done on it at the time of my inspection. A considerable amount of diamond drilling has been done on the property.

A new compressor of about 1,2)) cubic feet capacity has been installed and a new 125-h.p. boiler. During the year the company were inconvenienced by the loss of their power plant from fire.

Instructions were given regarding the removal of the magazine to a proper position.

Mr. Robt. A. Bryce is superintendent.

### Scott Lease

Mr. O. N. Scott of Toronto and associates have taken a 20-acre lease of Peterson lake. The area leased lies south of the Kerry Mining Company's lease. Two shafts have been sunk to a depth of 25 feet and 50 feet respectively, and a contract let to the Kerry Mining Company to drive a drift on the lease from the first level of their shaft.

Silver Cliff (foreground) and King Edward silver mines, Cross lake.

### Silver Cliff

This property is owned by the Silver Cliff Mining Company, of which Company Rinaldo McConnell, J. F. Barnet and H. Hennessey are the principals. The claim has been sold to Dr. W. Beattie Nesbitt and associates, but the owners hold a mortgage on it. The north half has been worked for a time by the mortgagors, and the south half by the original owners.

On the south part of the claim an adit has been driven west 200 feet to the first vein, on which drifts have been run north and south 200 feet and 250 feet respectively. Raises have been put through to the surface on each of these drifts. The main adit has been driven 200 feet further to the second vein, on which about 300 feet of drifting has been done. A raise has been started to the surface, and a winze sunk about 40 feet in the north drift.

No work was being done at the date of my inspection, January 22nd, 1909.

### St. Anthony Lease

The St. Anthony Mining Company have obtained a lease of 20 acres of Peterson lake, south of the Union Pacific lease, and across the lake from the Kerry Mining Company. A shaft has been sunk on the shore to a depth of 80 feet, but no drifting has yet been done.

Instructions were given as to timbering the shaft.

Mr. S. D. Maddin is in charge of the work.

### Shamrock

The Shamrock Silver Company have been working on the south half of the southwest quarter of the south half of lot 1, concession 4, Coleman, adjoining the Beaver to the north. The shaft is 100 feet deep. A cross-cut has been driven from the shaft west 128 feet to the contact between the Keewatin and diabase. From here drifts have been run south 150 feet and north 140 feet. Since my inspection the shaft has been put down further and a winze sunk from the south drift.

Another shaft was being sunk 600 feet north of No. 1.

The power plant consists of one 100-h.p. return tubular boiler, a straight line compressor and hoist.

Mr. A. M. Bilsky is managing director of the Company.

### Silver Leaf

The Silver Leaf Mine was worked for part of 1908 by Mr. H. D. Symmes under lease from the Silver Leaf Mining Company. The lease was, however, not renewed, and the Company are now operating the mine.

The shaft in the continuation of the Crown Reserve vein is 215 feet deep, with levels at 75 feet, 135 feet and 200 feet. On the first level a drift has been run west 109 feet, and from the end of this drift a cross-cut 180 feet. On this second level a drift west has been run 291 feet and a cross-cut 56 feet. On the third level a drift has been run west 67 feet and cross-cut south 40 feet.

Instructions were given regarding derrick and men riding in the bucket.

Considerable diamond drilling was being done on the property.

Mr. F. M. Thorne is superintendent in charge.

### Strathcona

The Strathcona Silver Mining Company are conducting operations on the southeast quarter of the north half of lot 10 in the second concession of Bucke. One shaft has been sunk to a depth of 75 feet and about 80 feet of drifting done at this level.

Instructions were given to put the shaft in proper condition.

A small upright boiler is being used. A diamond drill was at work on this property at the time of my inspection.

Mr. R. Sohier was superintendent in charge.

### Silver Cross

At the Silver Cross mine work had just been resumed at the date of my inspection, January 22nd, 1909, with Mr. Hurdman in charge and Messrs. Campbell and Deyell consulting engineers.

The shaft to be worked is now 95 feet deep. It is proposed to drift and cross-cut from the 60-foot level. Another shaft north of the road to Cross lake is 50 feet deep. A small boiler and hoist are being used.

### Susquehanna Lease

The Brydge Syndicate have taken the above lease of the north 20 acres of Peterson lake. A shaft has been sunk on the shore to a depth of 50 feet.

Machinery consisting of one 100-h.p. boiler, compressor and hoist has been installed and a power house built.

### Temiskaming and Hudson Bay

Four levels have now been opened up at the Temiskaming and Hudson Bay mine. The first level at 60 feet remains about the same as was described in the last Report, except that some stoping was done. On the second level at 100 feet drifts have been extended east a total distance of 310 feet and west 200 feet. From a point in the east drift 170 feet from the shaft a drift has been driven southeast 120 feet to the Trethewey line. Some drifting has been done on the Trethewey ground on a vein struck near the line. From the shaft a cross-cut has been driven north about 400 feet to the north vein. A raise was put through to the surface on this vein, and 65 feet of drifting done on the level. A winze has been sunk on the vein 65 feet and from the bottom of the winze drifts run east 250 feet and west 180 feet, and a cross-cut north from the west drift 120 feet. On the third level at a depth of 150 feet a drift has been run east about 250 feet. No drifting has been done on this level west of the shaft. On the fourth level at a depth of 200 feet a station has been cut and a drift started east.

Temiskaming and Hudson Bay silver mine.

Instructions were given with respect to guard rails at the shaft and winze, and bucket riding in the winze.

On the northwest quarter of the north half of lot 7 in the fifth concession of Coleman, north of the Silver Queen mine, the Company have sunk a shaft 50 feet deep and have drifted southeast 350 feet towards the Silver Queen line.

Instructions were given regarding the thawing and storage of dynamite.

Mr. J. R. Kinler is manager for the company.

### Trethewey

The greater part of the work done in 1908 was in No. 2 shaft. On the first level a drift east has been run 110 feet and connects with No. 3 shaft. The west drift connects with the workings of No. 1 shaft. On this level considerable stoping has been done. The second level at a depth of 110 feet has drifts east 150 feet, west 120 feet and cross-cuts north 120 feet and south 100 feet. There are a number of short drifts

on stringers from the main vein. The stope is being carried up to the first level. This also connects with No. 3 shaft 90 feet east. No. 3 shaft has been sunk 60 feet below this level, and 100 feet of drifting done on it and some stoping.

Instructions were given regarding the ladderway and passage way around the shaft.

The ore house has been remodelled. The ore is trammed on surface from the No. 2 shaft to the ore house at No. 1 shaft. The officers of the company remain the same, with Mr. G. F. McNaughton as superintendent.

### Trinity

This property is situated on the west shore of Cross lake on the south part of the east part of lot 2, in the fifth concession of Coleman. A shaft has been sunk 150 feet, the first 60 feet being through subsoil. It is the purpose of the company to drift out under the lake.

A 60-h.p. boiler, straight line compressor and hoist have been installed and camp buildings erected.

No work was being done at the time of my inspection.

### Union Pacific Lease

The Union Pacific Cobalt Mines, Limited, have a 20-acre lease on Peterson lake on the west shore opposite the Little Nipissing lease. A shaft has been sunk to a depth of 100 feet on the shore.

Instructions were given to have shaft timbered properly before further work was done.

Mr. H. H. Short is looking after the work for the company.

### University

The University mine is controlled by La Rose Consolidated Mines, Limited. During the summer of 1908 an open cut was made on a cobalt vein near the Foster line. Since that time a shaft has been sunk to a depth of 60 feet on a small vein west of Giroux lake post office A shaft house and hoist have been erected.

Power is supplied from the main power plant, which is located near the No. 1 shaft and has been described in former Reports.

### Temiskaming

The Temiskaming mine is still the only shipping property in South Coleman. During the year a great many changes have been made, both underground and on surface. A new three-compartment shaft has been sunk 360 feet northeast of No. 1 shaft. On this shaft a 60-foot steel head frome has been erected, the first to be used in the camp. This has been connected with the workings on the 200-foot level and is nearly so with the 250-foot level. A new power house has also been built and a new power plant installed, consisting of a compressor developing 1,800 cubic feet of air per minute, a double drum 18 inches by 32 inches first motion hoist, two water-tube boilers and an 18-K.W. generator. The shaft is equipped with safety cages. New camp buildings have also been erected.

On the 200-foot level from No. 1 shaft, parallel drifts have been run southwest on the lot 120 feet. North of the shaft on the No. 1 vein, a drift has been run 230 feet to where it joins No. 2 vein. No. 2 vein, about 40 feet from No. 1 vein, has drifts run south 200 feet from cross-cut which is driven 230 feet east from No. 1 vein, and north 300 feet. The No. 2 shaft is 360 feet northeast of No. 1 shaft, and

connected with No. 2 vein by a 25-foot cross-cut. On the 250-foot level the drift on No. 1 vein has been extended northeast 260 feet. No. 2 vein is cut by a cross-cut 35 feet in length and has 250 feet of drifting done on it.

Considerable stoping has been done on both levels and raises have been put through on the vein.

Mr. Norman R. Fisher is general manager for the company.

#### Victoria

The main shaft has not been worked for several months. A shaft was being sunk west of the main shaft. This has reached a depth of 75 feet.

In the main shaft at the 75-foot level a drift has been run west 100 feet and cross-cuts north and south 20 feet and 50 feet respectively have been run. On the 150-foot level 315 feet of drifting has been done and 190 feet of cross-cutting. From the north cross-cut on this level a winze has been sunk 95 feet.


Temiskaming silver mine.

The power plant consists of one 80-h.p. boiler, the high pressure half of a 10-drill compressor and a hoist.

Mr. John Harris is superintendent.

#### Violet

This property is now controlled by La Rose Consolidated Mines Company. The work done on it during the year consisted of trenching and test-pitting.

#### White Prospect

Mr. W. J. White of New York is sinking a shaft on the south shore of Giroux Lake on the Silver Hill property, for the purpose of prospecting the bed of Giroux lake. A shaft has been sunk to a depth of 100 feet. It is the intention to sink to 150 feet and drift out under the lake.

Mr. A. McGarry is in charge of the mining work.

## South Lorrain

Considerable stripping and test-pitting was done during 1908, in that section of country between the south boundary of Lorrain and the Montreal river. A number of veins, carrying some silver values, have been found. These veins occur chiefly in the diabase and in the Keewatin near the contact with the diabase. The occurrence is quite similar to the veins at Cobalt, but the ore in some of the veins differs, in that it sometimes occurs with quartz as gangue along with calcite. The silver in places occurs as fine, hair-like threads, almost mossy in appearance, as at the Keeley mine.

The map of this area by Mr. A. G. Burrows, accompanying this Report of the Bureau of Mines, shows the location of the properties on which the best discoveries have been made, occurring near the contact of the Keewatin and diabase. No veins carrying high values in silver have been found in the conglomerate here.

#### Bousquet Claim

On H.R. 103 and 104, south of the Keeley and Woods claims, Messrs. Grover and Smith did considerable trenching during the summer of 1908. No mining work has yet been done.

#### Haileybury Silver Mine

On H.R. 16, the Haileybury Silver Mining Company have sunk a shaft on their No. 1 vein to a depth of 100 feet. This vein is chiefly smaltite and niccolite, and has a dip to the north of 70 degrees. At the bottom of the shaft a drift has been run east 15 feet on the vein. On No. 2 vein, 500 feet south, a shaft has been sunk 25 feet. This vein strikes about north and south, and has been stripped for some distance. Some silver values have been found in it.

Mr Cyril T. Young is president of the company and Mr. A. Brough managing director.

#### Keeley Mine

The Keeley mine is located on H.R. 19, about 3½ miles from lake Temiskaming. The property is owned and operated by the Keeley Mine, Limited, of which Mr. Wishart of New York is president and Mr. Boyd Magee manager.

The main shaft has been sunk to a depth of 125 feet, with the first level at 65 feet. On this level drift have been run 80 feet east and 94 feet west. Some stoping has been done both east and west of the shaft. A head frame has been erected over the shaft and hoisting done by horse and whim. Another vein was found by trenching south of the main vein. This vein on surface showed a fairly good width of smaltite. A shaft is being sunk upon it.

Machinery is being installed, consisting of a 220-h.p. gas producer, one 150-h.p. gas engine to drive compressor of 1,015 cubic feet capacity, and a 40-h.p. high speed gas engine directly connected to a 40 kilowatt generator. The generator is to furnish power for electric hoist, electric station pump, pump at the lake some 2,300 feet distant and light for camps. This electric power is to be delivered at 220 volts.

Dining-room, two bunk houses, office, assay office, blacksmith shop and ore house have been erected.

#### Harris-Lorrain Syndicate

On H.R. 88, adjoining the Wettlaufer on the east, the above syndicate have done considerable trenching, and preparations have been made for sinking shafts on some of the discoveries.

#### H. R. 24

This claim, lying to the east of and adjoining the Haileybury Silver Mining Company, property, is owned by Mr. Mark Harris. Captain Terrill is in charge of the work and has sunk two pits to the depth of 22 feet and 18 feet respectively.

### Maidens Silver Mining Company

On mining claim H.R. 70, which lies about one mile northwest of the new Government dock, the above company are doing mining work, south of the government road and consisting of adits driven south into the hill, which has an elevation of over 100 feet above the road. No. 1 adit was driven 63 feet through clay to the rock and 135 feet farther, part of it being on the vein which was encountered. Another adit has been begun 300 feet west of the No. 1 and has been driven 50 feet through clay to the rock.

Camp buildings have been put up.

Mr. A. J. Murphy is president and managing director, and Mr. W. R. Montgomery superintendent.

Keeley silver mine, South Lorrain.

### Proudfoot Fraction

This fraction, H.R. 25, lies to the north of the Keeley and adjoining it. It is owned by Messrs. Nesbitt and Crompton. Prospecting was done during the summer of 1908, and a shaft sunk 40 feet on a calcite vein near the north boundary of the Keeley mine.

### Wettlaufer

This claim, H.R. 85, adjoins the Keeley to the southeast. Most of the claim is in diabase, and the vein found runs about at right angles to the contact of the diabase with the Keewatin, and in a northeast and southwest direction. The vein or fissure has been stripped for a considerable distance, and some test pits have been sunk on it. The vein opens up in lenses in places 3 to 4 inches in width, carrying good values in silver. A company has been formed known as the Wettlaufer Lorrain Silver Mines,

Limited, of which Mr. Wettlaufer is president, Mr. F. C. Loring managing engineer, and Mr. A. C. Bailey, superintendent.

A small boiler and hoist has been put in and shaft sunk to a depth of 40 feet. It is the intention of the Company to instal boilers and compressor at an early date.

#### Woods

The claims, H.R. 21 and 22, are owned by the original owners of the Keeley mine, Messrs. Keeley, Jowsey and Woods, and lie immediately to the west of it. Considerable trenching was done on the two claims during 1908, and veins carrying silver discovered. A shaft has been sunk on it 25 feet and sinking was to be continued. This vein had a strike of about north and south, and was only a short distance from the west boundary of the Keeley claim.

Camps have been built on the claim.

#### Wiltsey

This claim (R.L. 482) is owned by a syndicate in which Mr. A. M. Bilsky of Cobalt is interested. It lies about 2¼ miles from the lake and 1½ miles north of the Keeley. A 50-foot shaft has been sunk on it.

### Elk Lake Area

In this area, which includes those properties in the townships of James, Mickle, Farr, Smyth, Tudhope, Barber and Willet, there are a large number of companies engaged in development work at the present time. Very few of these had any work done at the time of my inspection and only one, the Moose Horn, had a steam plant at the mine. During the winter of 1908-09 about 20 steam plants were taken in and set up. About half this number of compressors have been installed, with a corresponding increase of boiler capacity. No ore has yet been shipped to the smelters from any of the mines in this area.

A number of the properties now operating will only be mentioned, as there has been no opportunity yet to inspect them.

#### Devlin

On the northeast quarter of the south half of lot 1 in the first concession of James, the Devlin Mining Company are carrying on both prospecting and mining operations.

No. 1 shaft has been sunk to a depth of 50 feet, using horse whim and derrick. It is the intention to sink a little deeper here and then drift.

Another pit is being sunk about 500 feet from the above shaft. This pit was only about 10 feet deep. Camp buildings have been erected on the claim on the shore of a small lake.

#### Cragg

No work was done on these claims at the time of my inspection. They are located north of the river in James and Smyth. On one of the claims a shaft 75 feet in depth has been sunk, besides a number of test pits.

Mr. Shirley R. Cragg has been in charge of the work.

#### Elk Lake Discovery

This claim is situated about 2½ miles east of Elk City and near the road to Charlton. It is owned by the Elk Lake Discovery Mining Company, of which Mr. J. G. Harris is superintendent.

A power plant has been installed, consisting of a 60-h.p. boiler, straight line compressor and hoist. A shaft is being sunk on one of the veins discovered, a depth of 50 feet having now been attained. It is the intention of the company to sink the shaft to at least 100 feet in depth.

### Elk Lake Silver Cobalt

This property is situated about 2½ miles from Elk City and adjoining the Elk Lake Discovery. It is owned by the Elk Lake Silver Cobalt Mining Company, of which Mr. F. L. Culver is president.

A small plant has been installed and two shafts sunk to a depth of 40 feet and 25 feet respectively.

### Gavin-Hamilton

The Gavin-Hamilton Mining Company control 160 acres of mining land near Elk Lake. A 5-drill straight line compressor, and a 65-h.p. boiler and hoist have been installed. A shaft has been sunk to a depth of 55 feet, and 90 feet of cross-cutting done.

Camp buildings have been erected for the accommodation of 40 men. Mr. P. J. Fleming is superintendent in charge.

### Langham

Mr. H. H. Lang of Cobalt and associates have begun work on claims in Tudhope and have organized a company known as the Langham Mining Company.

A small plant has been installed and work begun.

### Lucky Godfrey

The Lucky Godfrey claims are situated in the southeast corner of the township of James near the Montreal river. The work done up to the present has consisted chiefly in trenching and test-pitting.

### McFadden

On the northeast quarter of the south half of lot 12 in the first concession of Tudhope, Mr. D. McFadden was prospecting and sinking a shaft. This shaft was at the time of my inspection, October 28th, 1908, 50 feet deep. Instructions were given regarding condition of hooks and derrick.

### Mother Lode

On the northwest quarter of the south half of lot 8 in the sixth concession of James, on the claim formerly known as the Gates, the Mother Lode Mining Company have been working steadily for the past year. Some work was done on the vein on top of the hill, a test pit having been sunk 10 feet. An adit has since been driven in on the vein about 65 feet below the outcrop, a distance of 250 feet. At 65 feet from the mouth of the adit a winze is being sunk on the vein, a depth of 45 feet having been attained. The vein consists of specular iron and calcite. It occurs in diabase, and carries silver in part.

Instructions were given to keep the explosives out of the workings when not in use, and to provide a suitable place for thawing them.

Mr. W. H. Shutt was in charge at the time of my inspection.

### Moose Horn

On the north half of the north half of lot 4 in the fifth concession of James, about half a mile from Elk City, the Moose Horn Mines, Limited, have been sinking shafts and prospecting during the year. This was the first company in the Elk Lake area to bring in a small boiler and hoist, and to use a power drill. One shaft has been sunk 35 feet in depth and a second shaft to a depth of 65 feet. This latter shaft is to be the permanent one from which the other veins or fissures on the claim can be cross-cut. A new compressor plant has been purchased and is on the ground ready for installation. This consists of a 3-drill straight line compressor and a 80-h.p. boiler.

Instructions were given to have proper ladder way constructed and guard rails placed around the shaft.

### Otisse

On mining location E.B. 21 in the township of Mickle, near Silver lake, the Otisse Mining Company have begun mining operations. Very little mining work was done at the time of my inspection, but during the winter one shaft was sunk to a depth of 50 feet and other shafts begun. The veins or fissures are parallel, have a strike of 5 degrees north of east, and occur in the diabase.

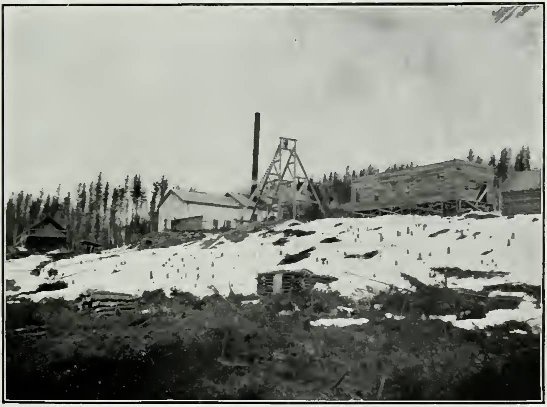
During the winter a complete power plant consisting of a 10-drill compressor, two 80-h.p. boilers and hoist was installed.

Camp buildings have been erected for the accommodation of 30 men.

Mr. F. C. Loring is managing engineer.

### Otisse-Currie

This property, consisting of several claims in the vicinity of Silver lake in the township of Mickle, is being operated by the Otisse-Currie Consolidated Silver Mines, Limited.



Otisse silver mine, Silver lake.

A shaft has been sunk on one of the claims to a depth of 60 feet and drifting begun. During the winter boilers, hoist and compressor were hauled in and set up.

Mr. M. Fleming is superintendent in charge.

### Otisse Claim near Hubert Lake

Just west of Hubert lake, work was being done in October, 1908, by a company which had the claim under option. Mr. L. Mapes of Pittsburg was in charge.

A shaft had been sunk 75 feet deep, and drifting begun on an aplite dike in diabase. Hoisting was being done by horse whim. Instructions were given as to ladderway and guard rails, and to discard the open hook in hoisting.

A number of other claims in this area have had steam plants installed on them during the winter, but have not been inspected.

## Maple Mountain Area

### Foster

The Canadian Ores, Limited, under the management of Mr. R. W. Foster, were working continuously during 1908. developing the claim R.S.C. 56 purchased from the White Bros. An open cut was made on one of the veins, and from 8 to 10 tons of ore taken out. A shaft has also been sunk to a depth of 125 feet. On the 70-foot level a cross-cut was driven 90 feet. It is the intention of the manager to sink to 150 feet and then cross-cut to the main vein north of the shaft. The company are getting the foundation ready for installing a 100-h.p. return tubular boiler and air compressor developing 950 cubic feet of free air per minute, and a 12 by 15 inch hoist having a 4-foot drum.

Camp buildings have been erected for the accommodation of 40 men. The company during the summer take in their supplies by way of the Montreal river, Mattawapika river, Evelyn lake and a wagon road which they have constructed. Last winter a winter road was cut through the bush from Pork rapids on the Montreal river to the mine, and supplies and machinery brought in.

### Stevenson

A shaft has been sunk on this claim to a depth of 65 feet and a cross-cut driven, but a large volume of water was encountered, and work was discontinued until the boiler and hoist could be installed.

### Darby

Prospecting and assessment work was done on these claims during the year, but no active mining development carried on.

The development work required by the Mining Act was also done on a number of other claims in this area.

## Gowganda and Miller Lake Area

No inspection has been made of the workings in this area as yet. A description of the more important properties will be found in Mr. A. G. Burrows' report on the Gowganda, Miller and Elk Lake areas, Part II. of this Report.

## Larder Lake

A large number of claims in this camp have had the assessment work done on them, but it was impossible to visit all the workings, the more accessible and those on which work was being done alone being inspected. There has been little mining work in the camp to date, and what has been done has not yet demonstrated just where the richest ore is in the ledges. The concentrates, consisting chiefly of iron pyrites, of which there was considerable in the rock already milled, are claimed by the owners to run about $8.00 per ton. Whether the gold is intimately associated with the iron pyrites has not yet been proven, but it is thought to be the case. Some of the properties show some very nice free gold, but these rich pockets appear to be small, and the success of the mines seems to depend on the working of a large tonnage of low grade ore. The grade of ore may be raised by sorting when it has been proven which is ore and which is rock. As to the permanency or value with depth of the veins, nothing can be said, as at the time of my inspection the deepest shaft in the camp was but 42 feet. Some of the companies have already become handicapped with a large expenditure, and but little work done to show for it.

### Harris-Maxwell

The Harris-Maxwell Larder Lake Gold Mining Company have been carrying on work on claims H.S. 114 and 115 about one-half mile northeast of Larder City. Most of the work has been done on H.S. 115. On this claim some open cutting and trench-

Stamp mill, Harris-Maxwell gold mine, Larder lake.

Open cut, Harris-Maxwell gold mine, Larder lake.

ing has been done on the top of the hill, which is about 90 feet above the lake level. At a point on the lake side about 10 feet above the lake level, an adit has been driven in on the deposit, a distance of 25 feet, then turning to the south for a distance of 35 feet. The ore in the adit is similar to that on the surface, consisting of quartz stringers through a serpentine carbonate rock. A 10-stamp mill has been erected on the north-west side of the hill, and had at the time of my inspection made one run of 30 tons. A tramway has been built from the open cut on the top of the hill to the mill, where the ore is fed to a crusher and into bins and then to the stamps by a Challenge feeder. The pulp from the plates is concentrated on a Wilfley table. The concentrates are chiefly iron pyrites, said to carry several dollars in gold.

The president of the company is Mr. W. Wakefield, and secretary-treasurer, Mr. Robt. Patterson.

#### Larder Lake Proprietary

The Larder Lake Proprietary Gold Fields, Limited, had at the time of my inspection 36 claims. Most of the work, however, had been done on C.E. 33, which is on the north side of Larder lake, about seven miles from Larder City. A shaft has been sunk 40 feet in depth and considerable trenching done.

A 5-stamp mill has been erected on the water front on mining claim C.E. 31. The ore is hauled by wagon from the shaft to the mill, a distance of 1,000 feet. The machinery in the mill consists of one 50-h.p. boiler, 6 by 10-inch Gates crusher, 40-h.p. engine and a 5-stamp battery. A few test runs have been made at the mill.

Colonel G. S. Ryerson is president of the company and Mr. T. H. Brooks, manager. Assessment work has been done on the other claims.

#### Reddick

The Dr. Reddick Larder Lake Mines, Limited, control mining claims H.J.B. 30, 31, 29, 28, 32, 33, and H.F. 33, situated to the north of Larder lake. Most of the mining work is being done on claim H.J.B. 30. A shaft has been sunk on this claim to a depth of 42 feet, and a few test pits to a depth of 10 to 30 feet. The ore that was being milled at the time of my inspection was being taken out by open cut work. A boiler has been set up and steam used for drilling. A tramway about 1,000 feet long has been built from the mine to the mill. The latter is situated on the south side of the hill north of the lake on H.J.B. 30.

At the time of my inspection 10 stamps were in operation, and 10 stamps more being put in. An 80-h.p. boiler and engine have been set up for driving the machinery. One small run was made during the summer. Since then a considerable number of mill tests have been made.

Dr. Reddick was president of the company, and Mr. W. Morley Ogilvie superintendent.

Camp buildings for the accommodation of 40 men were erected near the mill. It was the intention of the management to sink the shaft to a depth of 100 feet and cross-cut the deposit, in order to ascertain, if possible, its probable extent and value.

#### Gold King

Claims H.F. 140 and 141 are owned by a syndicate of five men. Work has been done chiefly on H.F. 140, consisting of driving an adit into the hill, a distance of 35 feet, stripping the deposit on the hill side and doing a little open cutting. The quartz ledge has a strike of east and west; it is composed of quartz stringers through a serpentine carbonate gangue. Some free gold could be seen in the quartz. The top of the hill, on which the deposit occurs, is about 100 feet above lake level.

Larder Lake Proprietary Company's stamp mill, Larder lake.

Dr. Reddick Company's stamp mill, Larder lake.

### Richardson

On claims L.M. 31 and 32 assessment work has been done. This work consisted chiefly in sinking a number of test pits on the ledge. The quartz occurs here as stringers through the serpentine and carbonate rocks.

### H. S. 109

On this claim, owned by the Cobalt and Larder Lake Gold Mining Company, only the assessment work has been done, showing a somewhat similar occurrence to the Richardson.

### Big Pete Canadian Mines

On claims H.F. 31 an 32, about two miles north of the Reddick, the Big Pete Canadian Mines, Limited, have been prospecting and testing the deposits. The claims occur in a belt of serpentinized carbonate rocks, and three pits have been sunk to a depth of 10 to 12 feet, in addition to considerable stripping. A diamond drill has been at work for some time testing the deposits as to depth.

### Craig

These claims are about four miles north of Larder City. The work done consists of stripping, test-pitting and sinking two shafts to a depth of 25 feet each.

## Temagami Area

In the section of country tributary to the T. & N. O. railway, between Temagami and Latchford, a variety of minerals are found in quantities sufficient to induce companies to undertake work on them. These consist of iron pyrites, chalcopyrite, arsenopyrite, molybdenite and gold. Calcite veins are also being tested in the hope of finding silver.

### Northland

Iron pyrites has been shipped from this mine (formerly known as the Harris or Rib Lake mine) for the last two years. The property is situated near Rib lake about one half mile from the T. & N. O. railway, from which a spur line has been built. The main shaft is sunk to a depth of 175 feet with levels at 100 feet and 175 feet. Drifts have been run north and south on the first levels 150 feet and 250 feet respectively. The south drift connects with the open cut south of the shaft. On the second level drifts have been run north and south 165 feet and 200 feet respectively, and raises put through to the first level. Ore is being taken out from between the first and second levels both north and south by underhand stoping. The stopes are about 75 feet in length and vary in width from 10 to 20 feet. On the second level 75 feet north of the shaft a winze has been sunk a depth of 100 feet, and a drift started to the shaft preparatory to raising the shaft.

Instructions were given as to scaling, guard rails, ladderway and the handling of dynamite.

The property is operated by the Northland Mining Company, of which Mr. L. Hanna is manager.

### Sterling

About three miles west of Grey's siding, T. & N. O. railway near Arsenic lake on what was formerly known as the Little Dan, the Grey's Siding Development Company, Limited, are working chalcopyrite and mispickel. Mr. John McMartin is president of the company, Mr. Wm. Marshall managing director, and Mr. J. E. Wilson, superintendent.

Two pits are worked, the ore being taken out by open cut work. The ore in the pit to the east of the lake is mispickel, and that in the pit north of the lake is

chalcopyrite, carrying values in gold. At the former a shaft has been sunk to a depth of 60 feet, but the work at present is being done by carrying an open cut from the shaft south into the hill. At the latter a hole has been sunk about 15 feet. About 4 cars of ore were being shipped per day at the time of inspection.

Instructions were given regarding thawing of dynamite.

#### Temagami Gold Reefs Company

This company were engaged in sinking two shafts on mining location T.R. 12 on the west side of Net lake. No. 1 shaft has been sunk 40 feet on a ledge of quartz showing molybdenite. At this shaft a 15-h.p. boiler, a Westinghouse air pump and a small hoist have been installed, and head frame erected over the shaft. No. 2 shaft about 500 feet northeast of No. 1 has been sunk to a depth of 40 feet.

Mr. H. Dreany is managing director of the company, and Mr. E. J. Rossiter, superintendent.

#### Temagami Cobalt

The Temagami Cobalt Mines, Limited of which Mr. Wm. H. Hayden is engineer in charge, have taken up 30 claims on the east shore of White Bear lake about four miles east of Temagami. A shaft has been sunk on T.R. 1609 to a depth of 80 feet.

Instructions were given with regard to fitting up the shaft for the protection of the men.

On T.R. 1836 a shaft has been sunk 50 feet. Instructions were given at this shaft to have collar of shaft raised and doors put on.

Some assessment work has been done on the other claims of the group.

Mr. Joseph Sauvé is foreman in charge.

## IV.—EASTERN ONTARIO

### Gold

The condition of gold mining in eastern Ontario is about the same as in 1907. A number of companies have done a little work on their properties at times during the year. Among these are the Golden Fleece, Pearce, Boerth and a company near Gilmour Station.

#### Gilmour

The Gilmour Mining Company, Limited, of Syracuse, N.Y., are opening up a gold prospect on lot 30 in the nineteenth concession of Grimsthorpe township.

Mr. C. C. Snedeker is president of the company, and Mr. F. Landenberger manager.

A shaft has been sunk to a depth of 75 feet and a drift run northeast 210 feet. A couple of test pits have been sunk on the outcrop of the ledge. The plant at the shaft consists of a small upright boiler and hoist. A 5-stamp battery is being erected near the shaft.

### Iron

#### Mayo

This property is being operated by the Canada Iron Furnace Company under lease from the Mineral Range Iron Mining Company. No work was done during the winter but operations were resumed in March, 1909.

Work is being carried only on at No. 4 mine at present, where the 3-compartment shaft has been sunk to a depth of 75 feet on the ore body. A station has been cut at the 50-foot level and drifts run west to the open cut and to the east 25 feet. In the east drift a winze has been sunk 50 feet. From the bottom of this winze a drift has been run to the shaft where a station has been cut and the work of raising the shaft begun. As soon as the shaft is connected the drift west will be continued and stoping begun on this level. On the 50-foot level west the ore is being taken out by open cutting, the face

of the open cut being now 200 feet from the shaft. Here it is 35 feet wide and 30 feet in height.

The ore is dumped directly into a gyratory crusher from which it is carried by a travelling and picking belt to storage bins. This belt is about 50 feet in length and boys are employed picking out the rock. Two return tubular boilers and compressor developing 1,015 cubic feet of free air per minute have been installed.

Instructions were given as to scaling, the posting of notices and riding the buckets.

Mr. W. M. Stevens is superintendent, employing 75 men. About 75 tons of ore per day are shipped by the Bessemer and Barry's Bay railway to the junction with the Central Ontario railway near L'Amable station.

#### Rankin Property

Messrs. Coe and Rankin are opening up an iron property on the south half of lot 10 in the ninth concession of the township of Mayo. No work other than test-pitting, stripping and making a magnetic survey has yet been done.

Mayo Iron mine, Bessemer.

### Zinc

#### Richardson or Olden Mine

This mine was worked during most of the year. The Rothwell shaft is now 117 feet deep. At the 70-foot level drifts have been run east and west on the vein and some stoping done. The old No. 1 pit has also had some work done in it during the year. A new vein was discovered a short distance northwest of the Rothwell pit. This vein apparently cuts the other vein at an angle. At the time of my inspection the Rothwell and No. 1 pits were full of water, and work was being done on the new vein which had been sunk on to a depth of 17 feet.

Mr. M. J. Flynn is superintendent.

### Vankleek

On lot 24 in the eleventh concession of the township of Madoc Mr. W. A. Hungerford and associates are doing some development work. A shaft 75 feet deep on an incline of 70 degrees has been sunk on a quartz ledge carrying galena, sphalerite and chalcopyrite. The vein appears to be on the contact between the granite and greenstone schists. It dips to the west and has a strike of north by south.

Instructions were given as to guard rail around the shaft and thawing house. A small boiler and hoist are used for hoisting.

Mr. D. Phillips is foreman, employing a force of 10 men.

## Iron Pyrites

The mining of iron pyrites is becoming an important industry in parts of eastern Ontario, more particularly in Hastings county.

Surface showing of magnetite at Coe and Rankin's mine, Mayo township. The bank in foreground is ore.

### Hungerford or Sulphide Mine

Work at the Sulphide mine, owned by the Nichols Chemical Company, and situated about 4 miles east of Tweed on the Canadian Pacific railway, has been confined chiefly to the third level, and to sinking a winze on the north vein below this level. Some work has been done in lengthening the drifts on the north vein on the first and second levels, and breaking down ore in the stope between the first and second levels. On the third level the east drift on the south vein has been extended to 300 feet from the shaft. On the north vein the drifts east and west on the vein have been run to a distance of 400 feet and 325 feet respectively from the cross-cut. A winze has been sunk on the north vein 50 feet east of the cross-cut to a depth of 75 feet on the incline of the vein, and drifts run on the vein at this depth 95 feet east and 125 feet west.

A raise has been put through on the north vein from the third to the second level and stoping begun.

Instructions were given to have ladderway divided from hoistway and proper landings put in, and also regarding the handling of explosives.

The acid works located near the mine have been in operation continuously during the year. No marked change has been made in the plant.

Mr. W. H. De Blois is superintendent of the mine and works, employing about 75 men.

#### Craig

Mr. B. A. C. Craig has begun work on an iron pyrites deposit about one quarter mile west of the Sulphide mine. A shaft 40 feet deep has been sunk on the vein and a contract let to sink it to the 75-foot level.

Gillespie pyrite mine, near Queensboro.

#### Canadian Pyrite Syndicate

Mr. G. H. Gillespie has been opening up an iron pyrites deposit in the northeast quarter of lot 9 in the tenth concession of Madoc township, for the above syndicate. A shaft has been sunk 50 feet deep on the ore and drifts started. Another shaft 75 feet southeast is 20 feet deep. About 500 tons of ore have already been shipped. Two small boilers are used to furnish steam for drills and hoist.

### Feldspar

A few properties in Frontenac county shipped a little feldspar in 1908, but the great bulk of it came from the Richardson mine. These smaller properties were not inspected, as they were all closed down at the time inspection was made of the mines in that part of the Province.

#### Richardson

The open pit has now assumed the shape of a horseshoe, the central part of the horseshoe being a capping of quartz which is being mined during the winter months and shipped to Welland. About 6,000 tons of quartz were shipped during the winter of 1908-09. The pit is now about 130 feet below the top part of the deposit, having been sunk 25 feet deeper since last year. The main stope is being continued northwest from No. 2 pit under the capping of schist, which has to be removed for the safety of the workmen. During the summer months the feldspar is hoisted by derricks and cable way in 2-ton boxes which are lowered on to cars at the surface. These cars are then let down the hill to the barge on the lake by a system of balanced hoisting, the speed being regulated by a drum with brake.

Mr. M. J. Flynn is superintendent, employing during the summer about 40 men.

Talc mill, Madoc.

#### Graphite

The year 1908 was a fairly successful year in the graphite industry of eastern Ontario. The Globe Refining Company were operating their mine near Oliver's Ferry and the mill at Port Elmsley throughout the year, and the Black Donald Graphite Company near Calabogie were also producing. A little graphite was shipped from a couple of prospects near the Irondale and Bancroft Railway at Kinmount and Wilberforce.

#### McConnell

The work done at this mine consists of sinking on the vein following its dip, which is about 40 degrees to the horizontal. The chamber being quarried is 30 feet wide by 20 feet in height. Hoisting is done by skip, which dumps into an ore pocket, from

Globe Refining Company's graphite mill, Port Elmsley.

Globe Refining Company's graphite mine, near Port Elmsley; view showing shaft house.

which the ore is loaded into wagons to be teamed to the mill at Port Elmsley. A small, upright boiler furnishes steam for boiler and hoist. The back of the chamber needs constant attention. The foreman at the mine is James Benton.

A few improvements have been made at the mill. These consist of more sand screws, rolls for fine grinding, and buddles and bolts for sizing the graphite.

Mr. C. Meech is mill superintendent, and Mr. Allen Fraser manager for the owners, the Globe Refining Company.

#### Black Donald

The Black Donald Graphite Company, of which Mr. R. F. Bunting is general manager, has been producing refined graphite at the Black Donald mine for the last year. No mining was being done at the date of my inspection in June, 1909. The open cut was worked for two months in the fall of 1908 and sufficient graphite taken out to keep the mill in operation up to the present time. About 4½ tons of graphite are produced daily from the mill.

Some alterations are to be made in the mill to give them a greater capacity. Power from the mill is obtained from a power plant on the Madawaska river, two miles from the mine.

### Talc

With the erection of the mill at Madoc for grinding the crude talc and preparing it for the trade, the production from the Henderson talc mine on lot 14, in the fourteenth concession of Huntingdon has been considerably increased. Mr. S. Wellington is in charge of operations at the mine. During the winter a shaft was sunk on the deposit southwest of the open cut, to a depth of 100 feet. A drift has been driven on the talc northeast from the bottom of the open cut, which is 100 feet deep, a distance of 150 feet. Most of the talc at present being mined is from this drift. The talc is hauled by wagon from the mine to the mill about 1 mile distant.

Mr. G. H. Gillespie is in charge of the talc mill, buying the crude talc from the mine operators. About 8 tons of finished talc is produced every 24 hours. New screens have been put in for sizing the material. It is the purpose of the management to increase the capacity of the mill at an early date. Most of the finished material is sold in Canada, and of this, the greater part is used in the paper trade. The mill is situated near the Grand Trunk Railway station at Madoc.

### Mica

The demand for mica is still limited and the price is consequently low. As a result, most of the small mica properties in eastern Ontario have been lying idle. The mica trimming works in Ottawa have been taking on more hands, showing that trade in mica is on the increase.

#### Hanlan

This mine, owned by the Loughboro Mining Company, has been producing continuously during the year. The central part of the workings has now reached a depth of 165 feet, being an increase of 25 feet. Mica is being taken out by underhand stoping from the shaft, east for a distance of 200 feet. A pillar was being cut to the east of the shaft. West of the shaft a drift has been driven 60 feet on the vein which consisted at first of pink calcite. Mica crystals were, however, found, and stoping on this side of the shaft was begun. The mica is rough-cobbed at the mine, and then shipped to the General Electric Company, Ottawa.

A new shaft house was to be erected in the spring of 1909.

The management is the same as last year, Mr. G. W. McNaughton being manager and Mr. S. Cordick, superintendent.

#### Lacey

Work has been carried on steadily at this mine during the year. The only active operations at the time of my inspection were on the new deposit in the foot-wall side of the working. This deposit is parallel to that of the main workings, and about 60 feet from it. A drift stope has been run on this about 200 feet southeast, where it is intended to connect with the shaft sunk from the surface to a depth of 80 feet. The mica is being taken out by open cut just north of the air shaft. This open cut is about 45 feet deep, 75 feet long and 60 feet wide. A large swinging arm derrick has been placed on the hill above the open cut and all hoisting done by it.

Mr. G. W. McNaughton is manager for the owners, the Loughboro Mining Company, and employs a force of 40 men.

#### Silver Queen

This mine has been described in former Reports as the Smith mine, being situated on lot 13 in the fifth concession of North Burgess. Mr. Edward Smith is owner and Mr. Jas Thompson, foreman.

The pit is now about 80 feet deep on an average dip of 45 degrees to the west, from a point 25 feet from the surface. At 10 feet from the bottom of the pit, a stope drift has been driven 60 feet to the northeast. The productive zone appears to extend northeast by southwest. Considerable prospecting on the location was done during the summer, test pits having been sunk on several surface showings. In addition to the mica a considerable tonnage of apatite is produced, which is shipped during the summer by boat by way of the Rideau canal. The mica is shipped to England.

#### Mica Prospects

Messrs. Stoness and Kent have worked a property on the west side of Bob's lake during part of the year. This has been described in former reports of the Bureau of Mines. Most of the work being done is in surface pits. The mica is rough-cobbed at tho mine and shipped to Kingston to be cleaned and split.

In the vicinity of Perth in North Burgess Mr. Terry Smith has been doing a little prospecting. Messrs. McConnell and Watts have also been engaged in prospecting for mica in North Burgess.

#### Mica Trimming Works

In Ottawa the following companies are engaged in trimming and thin-splitting mica: The General Electric Company, corner Bridge and Albert streets; Laurentide Mica Company, corner Queen and Bridge streets; Eugene Munsell and Company, 400 Wellington street; Wallingford Mining and Mica Company, Sussex street; R. Blackburn, Sussex street.

In Kingston, Kent Bros. are also engaged in cleaning and thin-splitting mica.

### Corundum

The operations of the Canada Corundum Company at Craigmont were suspended during 1908. Work was resumed the first part of 1909 by the Manufacturers Corundum Company, who are operating the property under lease from the Canada Corundum Company.

The old system of open cut mining is still in vogue. The concentrating mill is run only day shift.

Mr. D A. Brebner is general manager for the operating company. A force of 135 men are employed at the mine and mill.

# IRON RANGES OF NIPIGON DISTRICT

By A P COLEMAN

In accordance with instructions from Mr. T. W. Gibson, Deputy Minister of Mines, my field work during 1908 was directed toward completing the mapping of the iron ranges near lake Nipigon begun two years before.

Mr. O. Bowles, fellow in Mineralogy in the University of Toronto, was appointed my assistant and proved energetic and efficient in every way.

During the two previous summers the iron ranges near Poplar Lodge on the east shore of lake Nipigon, and northwest of the lake on the head waters of Red Paint river near the Hudson bay watershed had been mapped. Three known iron ranges remained unmapped in the region, one near Little Long lake to the east, a probable extension of the Poplar Lodge range; a second near Black Sturgeon lake southwest of lake Nipigon; and a third to the north of lake Nipigon. It was decided to take up the work in the order just given.

## Routes to Little Long Lake

There are three possible routes to Little Long lake, by Sturgeon river and a chain of lakes from Poplar Lodge on lake Nipigon; north from Jackfish on lake Superior to Long lake and then west from its northern end; and from Heron bay up Pic river and then west over some small lakes to the northern end of Long lake. The route by Jackfish bay and Long lake was chosen as shortest going in; and the return journey was made by Pic river, easily navigated down stream, but difficult for canoes going up. As the canoe route by Long lake has received little attention it will be described here.

From the head of Jackfish bay the canoe route begins with the old road toward the Empress and other mines,[1] none of which are now working. With canoes two little lakes may be made use of on the way. Granite with felsite dikes, greenstone and green schist with quartz veins, are encountered on the way to the Empress mine, with an ascent, as shown by aneroid, of 187 feet.

Beyond the mine the route followed is the winter tote road used in taking in supplies for the fur companies' posts on Long lake; and travel over the long and rough portages is much worse than before. A very stiff climb leads to a third small lake, about a mile from the last one, 510 feet above lake Superior, after which there is another small lake followed by a steep ascent on a portage, reaching 646 feet above Superior, the highest point on the route. A succession of ponds or small lakes with short portages between brings one to the three-mile portage leading to Black river. The rocks exposed along the way are green schist, greenstone, and granite; but much of the surface below the highest point is covered with sand terraces having elevations of 967 to 904 feet above sea.

No old beaches or sand plains were found just north of Jackfish bay, perhaps because there was little drift material to be arranged by the waves; but descending towards Black river, terraces are very distinct, the river having brought down delta materials for deposit in lake Algonquin.

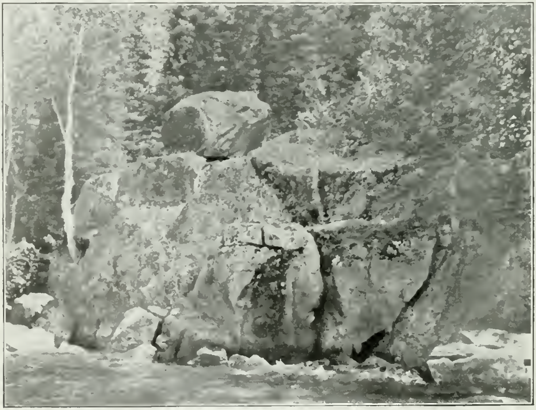
The trail follows Black river for a quarter of a mile up stream past rapids to a level of 380 feet above lake Superior, as determined by aneroid, beyond which it is navigable.

The rapids are caused by the boulders of a moraine, but on the hill side above gneiss of a grayish flesh color crops out, probably Laurentian. The sand terraces mentioned before continue as far as the moraine, but are not seen farther north.

[1] See Walter S. Davidson's report in "Survey and Exploration of Northern Ontario, 1900," pp. 138-9.

After 100 yards of swift water the river expands into a narrow lake for a mile and a quarter. On the east side granite shows for half a mile, and then is followed by green schist.

Above the lake there is swift water on the crooked river for two miles and a half before it expands again into Trout lake, which is several miles long, and has Keewatin rocks at the south end and Laurentian at the north. Black river enters the lake from the northwest, but the winter road and the canoe route go northward, following a chain of nine small lakes with short portages between. The highest of the lakes is 1040 feet above sea level, as determined by aneroid. The shores of the lakes or ponds are chiefly of gray gneiss with some granite, but the portages are often over stony morainic deposits or kame gravels. The watershed occurs between the 7th and 8th lakes on a portage half a mile long over morainic boulders. It does not reach an elevation of more than 1,050 feet above the sea.



An erratic on shore of Lake Nipigon.

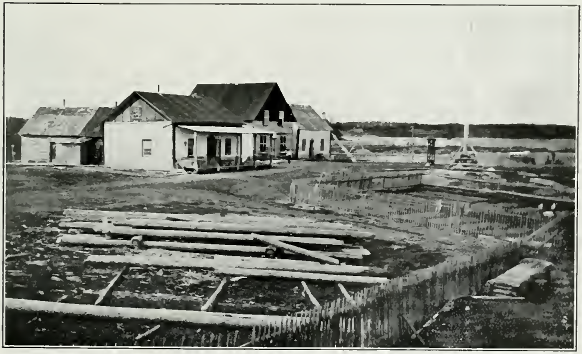
The whole distance from Jackfish to the south end of Long lake is about 29 miles by the winter road, but no doubt considerably less in a straight line, probably not more than 22. The route is rough and toilsome in summer and adapted only for very light travel with one trip over portages. It runs through typical "rocky lake" country with hills of gneiss or granite or Keewatin rocks rising in places 200 feet above the small lakes traversed. Toward Long lake morainic materials are present in large quantity, but no lake terraces are seen until the lake is actually reached.

In winter when the lakes and swamps are frozen, the route is traversed by teams, and makes a fairly good road except for the steep ascents on the way up from Jackfish.

## Long Lake

Long lake does not belie its name, since it is 54 miles long, less than a mile wide for a third of its length, and not more than three miles wide at any point. In a general way it is very straight, though there is one important bend 8 miles down from some-

High Falls of Kenogami river, 28 miles below Long lake.



Hudson's Bay Company's post, Long lake.

what west of north to about 30 degrees east of north. A good but brief description of this lake is given by Dr. Robert Bell[2] in his report on the "Country North of Lake Superior."

As mentioned by Dr. Bell, the southern end has rocky and mountainous shores, some points rising 500 feet above it, but the country grows more level toward the north and is low and swampy with few hills at the north end, where Kenogami (or English) river flows out. It has only insignificant tributaries and occupies a curious, narrow southward projection of the Hudson Bay watershed, which here reaches its nearest point to lake Superior. The northern part of the chain of ponds and small lakes just described, and Black river which drains them follow a continuation of the valley of Long lake with a very low divide (about 1,050 feet) between them. The cause of this narrow valley leading north from Jackfish bay to the Hudson Bay slope has never been worked out. A reference to this pass and to the terraces along the lake is given in the account of glacial lake Ojibway in another part of this Report.

As Dr. Bell's account of Long lake makes only brief allusions to the geology, the results of our coasting work may be given here.

At the south end of the lake a cliff of gray gneiss rises 300 or 400 feet from the water, and gray gneiss and schist with some dikes of pegmatite are found along the east shore to a point almost opposite the storehouses of the fur companies situated on a peninsula projecting from the west shore. These log houses were occupied by only one man at the time of our visit, and the supplies teamed in and stored there during the winter were rapidly being transferred to the posts at the lower end of the lake.

The rocks on the narrow upper end of the lake are coarse granite and gneiss, with green schist intermixed in about equal proportions, or fine grained gray gneiss or schist very like the Couchiching of the Rainy Lake region, cut by some pegmatite dikes. About six miles down a boss of coarse white granite rises as a cliff 200 feet high, cut half way up by a horizontal sill of diabase 20 feet thick forming a very conspicuous band. Beyond this to the north Keewatin-looking schist with granite dikes rises as cliffs, but presently the lake begins to widen with lower shores of the gray gneiss and schist resembling Couchiching, here and there penetrated by granite. Similar rocks are found along the eastern shore as far as the narrows half way up the lake, the green or gray schist having a strike running from northeast to due east, and averaging about 70° E., with southward dips from 60° to vertical. A few masses of hornblende porphyrite interrupt the schist near this point, and beyond them the strike of the schist has varied to 20° with a dip of 70° south. Soon, however, the strike returns to the more easterly trend, but the schist is now green and is mixed with some greenstone and amygdaloid, rocks characteristically Keewatin in appearance.

At Seven Mile point (7 miles from the north end of the lake) granite reappears on points and islands, and continues with some inclusions of greenstone to the post of Revillon Brothers, a mile or two from the outlet of the lake, where a sand terrace hides most of the surface.

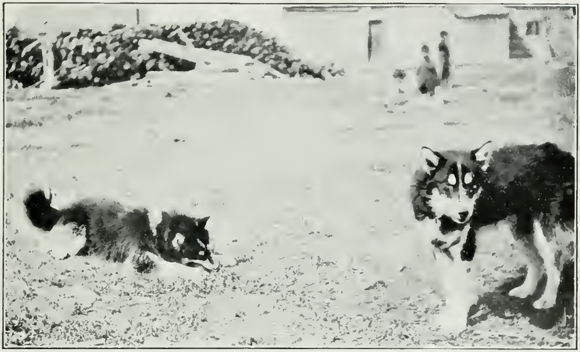
Just at their little harbor, rocks of varied kinds show themselves, chiefly coarse granite, cut by a dike of diabase 13 feet thick, and on the next point coarse hornblende porphyrite cut by granite dikes.

In the wider upper part of the lake the west shore could not be studied, but much of it is low and swampy or drift-covered.

It is evident that the lake runs not far from the contact of areas of Laurentian and Keewatin, with a larger amount of Keewatin rock visible, if the gray schist be reckoned to that formation as corresponding to the Rainy Lake Couchiching.

On the west side of the north end of Long lake near the Hudson Bay post there are fairly high hills of coarse granite rising through silt and clay, one of them forming a point which protects a small inner harbor from the waves of the lake.

[2] Geol. Sur. Can., 1870-71, pp. 335-7.



" Husky " dogs, Hudson's Bay Coy's post, Long lake. This type of dog is largely used for transportation purposes in winter.

Creek navigation between Little Long lake and Long lake.

### Long Lake to Little Long Lake

Going west from the bay near the post, the portage trail begins over low wooded ground, rising gently to low flat surfaces of granite, followed by boulders, and then by very wet muskeg to a small north and south lake, the length being about a mile and a half. The next portage begins on flat granite and ends in muskeg, with a length of about two-thirds of a mile After another little lake, a third portage of about the same length leads first over trembling bog, quite under water when we crossed it, then over drier ground to a third small lake with an outcrop of greenstone on the east shore, but mostly surrounded by muskeg. The fourth portage, also about two-thirds of a mile long, is not quite so wet, and some greenstone rises in low swells above the swampy ground. This leads to a small but navigable creek, reaching in a mile a lake with swampy shores, followed by a larger creek winding through marshy ground for about three miles, when a bay of Little Long lake opens out.

The region traversed is of a rather hopeless kind, more than half muskeg with low swells of granite or greenstone and a small amount of clay soil, with or without boulders, covered with a dense growth of small birches or spruces.

The portages, the muddiest and most disagreeable crossed during the summer, make up more than half of the journey. Except a low hill or two near the Hudson Bay post, no rising ground is to be seen between the two lakes.

### Little Long Lake

Little Long lake is a very tangled body of water with many bays, narrows, and islands, only roughly represented on either of the two maps available. It is about 12 miles long in a straight line, though the canoe route is somewhat longer than this. Before the first narrows no rock is seen; but rounding a point to the southeast one finds green schist a little beyond, with diabase on the next point. Most of the shores, however, are swampy or covered with low swells of drift, in one place west of the narrows rising as sand cliffs 20 feet above the water.

The western bay of Little Long lake presents more rocks on its shores than the eastern parts, though even here much of the shore is marshy; but west of the bay the character of the country changes, and a few fairly high hills of rock and moraine extend toward the divide between the water flowing into James bay and lake Nipigon.

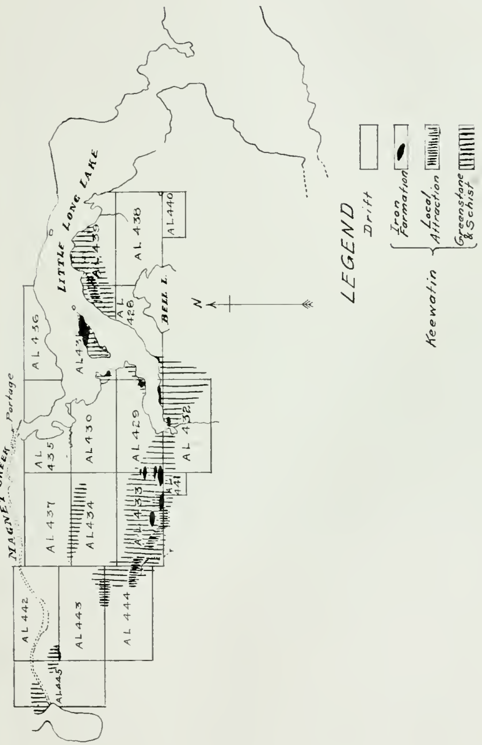
The object of our expedition was to study a number of iron ore locations taken up on or near the western bay, probably a continuation of the iron ranges east of Poplar Lodge, described in two former Reports.

#### Iron Claims on Little Long Lake

The first suggestion of Iron formation is found on the south side of the western end of the lake, in location A.L. 439, where low cliffs of Keewatin rocks rise west of a marshy bay. A few thin seams of banded gray and black material are evidently very low grade examples of the usual Iron formation. They are associated with green schist and irregular masses of coarse arkose, all squeezed and more or less drawn out and torn asunder. There are also many small seams of white quartz in shear zones.

The shore for some distance east and also west, in location A.L. 431, consists of the same rocks with a little of the Iron formation and, where drift-covered, often some local attraction. Inland in these two locations and also in A.L. 428, A.L. 438 and A.L. 440, no rock was seen, only swamp or muskeg, small, gently-rolling sand plains, and several esker ridges of sand.

The most important outcrop is at the east end of a large island included in A.L. 431, where stripping discloses a width of 24 yards of Iron formation intermixed with schist, some of the bands almost heavy enough to be ore. The colors at this stripping are gray and black, and there is magnetite enough to make the ordinary compass use-




Iron claims west of Little Long lake. Scale, 1 mile to the inch.

less, so that the dial compass was resorted to; but much of the material gives a red powder when pounded, showing the presence of hematite also.

Another stripping a short distance west shows 40 yards of surface, made up of very lean Iron formation, without schist, and containing some dull red jasper. The iron mineral here seems to be mainly hematite, though the compass is still useless. The greatest width of the banded silica and ore found on the island is 130 yards, and the total length of the outcrops is a little over a quarter of a mile. The rest of the island, where not covered with a thin sheet of drift and soil is of green and gray schist.

A little peninsula included in A.L. 431, on the west of a narrow channel, shows the same rocks but with very little of the banded silica.

On A.L. 436, on the north side of the lake, only marsh and low sandy plains, completely wooded, were found; and the same is true of A.L. 430 and of A.L. 435; but green schist crops out of the end of the northwest bay of Little Long lake, where Magnet creek comes in from the west.

Along the shore of the southwest bay, in A.L. 428, A.L. 429 and A.L. 432, rock is more frequently seen, on the south shore rising in places 20 or 30 feet, chiefly massive greenstone and green schist, but including some very lean Iron range along the northeast shore of A L. 432.

#### Iron Claims West of Little Long Lake

Seven locations have been taken up to the west of the lake, but only one of them, A.L. 433, shows outcrops of any importance, all the others being largely covered with drift or muskeg. The boundary line between 433 and 429 going northward ascends a steep rocky hill, consisting of green schist striking east and west with nearly vertical dip, and containing several bands of Iron formation, mostly very lean, but with some narrow streaks heavy and black with magnetite. In a number of places these ore bands are greatly contorted and torn asunder. The width of rock exposed is about a quarter of a mile, the northern part of the location being drift-covered.

Sections at short intervals to the west show much less rock, but of the same kinds, and in the southern half of the location strong local attraction at many points proves that there is magnetite below the covering of drift.

The other locations do not require a separate description. The few low outcrops of rock are all greenstone or green schist with an east and west strike. No actual Iron formation was found, though fairly strong local attraction occurs in several places

The surface is generally flat or gently rolling; but in A.L. 444 rather sharp morainic ridges were encountered. Probably half of the surface is covered with muskeg, and most of the rest with low swells of sandy till.

There appear to be two small parallel iron ranges running east and west in the region; the more important one including the north half of the island in A.L. 431, the other extending along the south side of A.L. 433 and stretching a little east and west into 429 and 444.

Until some work has been done in the way of test-pitting or diamond drilling, little can be said as to the value of these claims. The Iron formation resembles that of the southern range near Poplar Lodge, but, so far as known, the outcrops are much less extensive and of lower grade.

There is a gap of several miles between this Iron range and the most easterly one mapped by us in the Poplar Lodge and Sturgeon River region; but it is said that indications of iron ore have been found along the canoe route west via Magnet creek, which would fill in the gap. As we had no map or other definite information regarding this part of the region, it was thought unadvisable to spend time in searching for the Iron range to the west.

If ore bodies of importance should be found on Little Long lake only about 20 miles of railway would be required to connect them with the nearest point on the National Transcontinental.

### Northern End of Long Lake

The northern end of Long lake is of interest as presenting the southern edge of the clay belt as mapped in 1900. The clay soil at the Hudson Bay post lies flat, rising only from 3 to 10 feet above the water, and passes into swamp and muskeg toward the north and west. The soil, where cultivated in a small way at the post, seems good, and but for the poor drainage should be of some importance at a point where baled hay is brought in by canoe at a fabulous cost. Unless drainage schemes can be carried out on a large scale, however, no important area of farming land is available on the west shore of the lake. On the east near Revillon's post rather light and sandy land has been cultivated for some time by the Hudson Bay people, and more is now being cleared near the new post.

The two trading posts facing one another across three miles of water have been engaged for the last two years in transporting supplies for the engineers on the line of the National Transcontinental, which runs at a comparatively short distance to

Cultivating Clay Belt, Long lake.

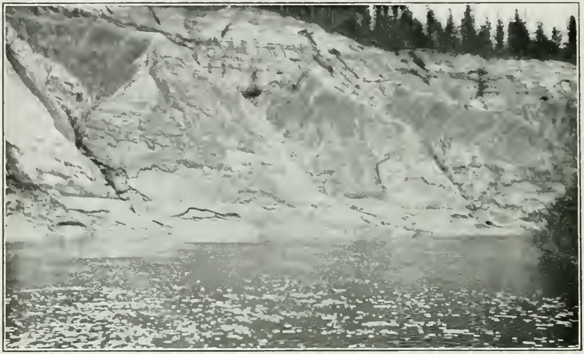
the north. A few parties of prospectors also have outfitted here. The hardships which some of the latter endure were shown in the case of a Mr. Bell, who went in during the winter, was attacked by scurvy and was on his way out with a band of Indians when we overtook the party and took charge of him as far as Revillon's post. He was so emaciated and crippled that he had to be carried in an improvised stretcher across the portages.

When the railway is completed and the temporary traffic connected with its construction is at an end, there will be only the dwindling Indian trade to justify the two stores unless white settlers come in, which seems improbable in a region so widely covered with swamps and muskegs. Except some spruce large enough for pulpwood, the timber is of little account.

### Pic River

The route most frequently used from Long lake to Heron bay is by McKay lake and Pic river, and more than one description has been published of its topographical and geological features. Dr. Bell in 1870-1 gives some account of the stratified sand

and clay of the lower part of the river and a more detailed account of the rocks found along it[3] and Mr. A. L. Parsons has described the bed rock outcrops in the last report of the Bureau of Mines.[4]



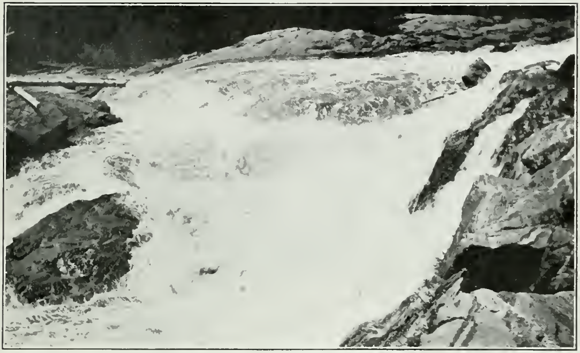
Clay bank, Pic river.

Pic river below falls.

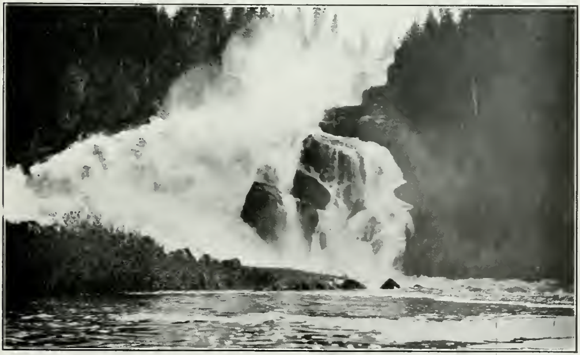
It will be unnecessary therefore to describe here the general geology or topography of the river; but some references to the Pleistocene deposits, conveying new information, may be given.

[3] G. S. C., 1870-1, pp. 237-333. [4] Vol. XVII, pp. 130-134.

Between Long lake and McKay lake the land is low and there is little variation in level. The portages are over low clay flats, partly boulder clay, with an esker ridge and some bouldery bands. A bay running northeast from McKay lake, at the

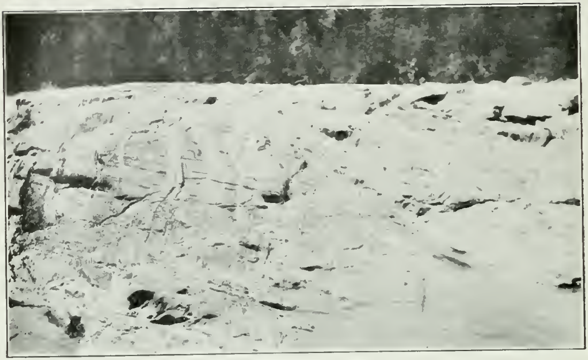


Falls at Lake Superior portage, Pic river.



Sandhill falls, Pic river.

beginning of a canoe route leading to lake Pegutchewan, has on its north side a terrace of stratified silt, evidently a lake deposit, rising about 8 feet above the water, or 1,020 feet above sea level; and a little beyond there is a somewhat higher terrace of well stratified silt and fine sand. Following up a creek connecting a chain of ponds,



Gneiss, Lake Superior portage, Pic river.

Stratified glacial lake clay. Mud river, below Long portage.

the shores are sandy and the region rises from 10 to 50 feet above lake McKay, forming somewhat rolling sand plains covered with jackpine. The higher surfaces are too irregular for wave work, and may be formed of dunes or esker ridges, probably deposited near the edge of the ice sheet. The portage to lake Pegutchewan crosses this rolling sand region, which forms the watershed at this point.

Going down Pic river from McKay lake a sand terrace appears above the first rapid, rising nearly as high as the terrace first mentioned (1,018 feet); and below that for two or three miles there are low sand plains turning to silty deposits as one goes down stream.

Viewed from a hill top at the second rapids the river shows a very narrow flood plain, and no more sand terraces. Very little drift is seen beyond this except some boulder clay, until a point is reached a mile or two above Sandhill portage, where a good sand terrace rises about 45 feet above the river, or 895 feet above the sea. The terrace seems to be lake-formed, with a flat surface and distinct stratification; but going inland the surface becomes irregular, suggesting esker ridges. Going down the portage path silt or clay is found at 818 feet underlying the sand.

At White Otter falls also there is a terrace, rising 757 feet above sea, or 157 feet above lake Superior, showing well stratified sand, silt, and some gravel; and about four miles farther down there is a cut bank about 120 feet high, consisting of finely stratified silt for about 80 feet, covered by 40 feet of stratified sand.

At Lake Superior falls, the last portage on the way down stream (44 miles in a direct line from the lake according to Dr. Bell), there is some boulder clay resting on the bed rock of gneiss with 50 feet of sand rising above it, and from this point down as noted by Dr. Bell, there are generally high cut banks and broad terraces of stratified clay at the bottom and sand above. About 15 miles below this, following the windings of the river, a terrace reaches 820 feet, as shown by aneroid, consisting of coarsely stratified clay to the top.

Four or five miles farther down, terraces show a similar arrangement of stratified clay at the bottom with ten feet of sand and silt on top, the strata of clay being an inch or two thick and pale gray and dark brownish gray alternately. The highest terrace here reaches 810 feet (aneroid) above sea level, or 210 feet above lake Superior. The most interesting feature is the finding of many small fresh water shells in some of the upper sandy layers, including fragments of unio or anodon, sphaerium, pisidium, poniobasis, limnaea, planorbis, amnicola, succinea, valvata, and probably two or three other genera. The point where the shells were found is about 35 miles above the railway bridge near Heron bay, considerably higher up the river than the locality where Dr. Bell found numerous species of shells including "two species of unio, one of anodon, one of margaritana," with four of the genera mentioned above. These were found nine miles below Herrick's line half way up a bank 60 feet high.[5]

Below the terrace at 810 feet, the banks of the river are lower, and a flood plain of clay generally forms the immediate bank. As this is 10 or 15 feet higher in the mid-June stage of water, almost vertical and clothed with a dense growth of small willows, it is by no means easy to land for camping purposes.

About 12 miles above the railway bridge a cut bank rising to 718 feet above sea, or more than 100 feet above the river consists of stratified clay in the lower part with 15 feet of yellowish silt on top. The railway levels give 685 to 708 feet for the continuation of this terrace toward the south.

As noted by both Dr. Bell and Mr. Parsons the river and its tributaries are rapidly cutting away the old delta materials of clay and sand, giving rise to ravines and "bad land" scenery. No doubt similar delta materials to the thick beds of clay, silt and sand disclosed by the river banks cut in the old delta formed in lake Algonquin and the Nipissing Great lakes in earlier days are now being deposited in Heron bay.

[5] G. S. C., 1870-71, p. 328.

# IRON RANGE NORTH OF ROUND LAKE

By E S MOORE

## Introduction

In order to complete the exploration of the iron ranges of the Nipigon region, a short trip was made to Round lake, to examine a small range reported from that vicinity. This lake is an expansion of the Mud river and lies about twenty-seven miles up the stream and directly north of Wendigo bay, on lake Nipigon. As the range proved to be of little importance, and a map issued by the Canadian Department of Mines[1] was found to cover the essential features of the region, exclusive of the Iron formation, the work done was confined mostly to mapping in detail the small band of Iron formation occurring just north of the lake. A short time, however, was

First falls on Mud river.

spent in exploring the neighborhood of the range for other outcrops of the Iron formation, and an excursion was made as far up the Mud river as the northern border of the Keewatin. The above mentioned map has been of great service in connection with the preparation of this report, and it will prove valuable to anyone intending to prospect in the vicinity of Round lake or farther west.

On the way up Mud river a portion of a day was spent on "Haystack Mountain," a large hill lying near the National Transcontinental railway line and about two and one-half miles west of Mud river. This visit was made for the purpose of verifying or disproving statements to the effect that a large body of titaniferous magnetite was associated with the hill, around which a number of claims had been staked. There

[1] Map of a portion of Northwestern Ontario, traversed by the Transcontinental Railway, between Lake Nipigon and Sturgeon Lake; compiled by W. H. Collins; No. 993.

proved to be no foundation for the rumors, beyond a very local deflection of the compass and the presence of small bunches of ilmenite, or titaniferous magnetite, which occurred as little segregations in the diabase.

### Mud River Between Nipigon and Round Lakes

The Mud, or Pikitigushi river, is one of the largest streams entering lake Nipigon. It was first surveyed in 1871, by Dr. Robert Bell and Mr. G. F. Lount. From its mouth to the foot of the first portage there are about nine and one-half miles of deep steady stream. The National Transcontinental railway line crosses it seven and one-half miles from lake Nipigon, and here on either side there are many miles of almost flat sand plain without rock outcrops, with many muskegs, and swamps of thick cedar and spruce. The bench marks along the line show that these plains have an elevation of 903 to 924 feet above the sea, and from 51 to 72 feet above lake Nipigon. The banks at this point are high, rising about 40 feet above the river, and all along the lower part of the stream they are muddy, and from this circumstance the stream has obtained its name.

At the first portage there is a combined fall and rapid, making a total change of elevation in the river of nearly 18 feet. The rock over which the water falls is a fine-grained, gray gneiss or schist of Keewatin age which resembles the Couchiching gneisses of Lawson. The portage is well beaten and only 215 yards long.

At 300 yards above this portage there is a second one 75 feet in length. This portage is necessary to pass an old log jam, which has blocked the channel.

Between the second and third portages there is a stretch of four miles of steady current. The latter portage is about one mile and an eighth in length, and crosses a silt and sand plain, which rises at the lower end of the portage, according to careful barometric readings, 75 feet above the stream. This makes the elevation of the plain approximately 959 feet above sea level and 104 feet above lake Nipigon.

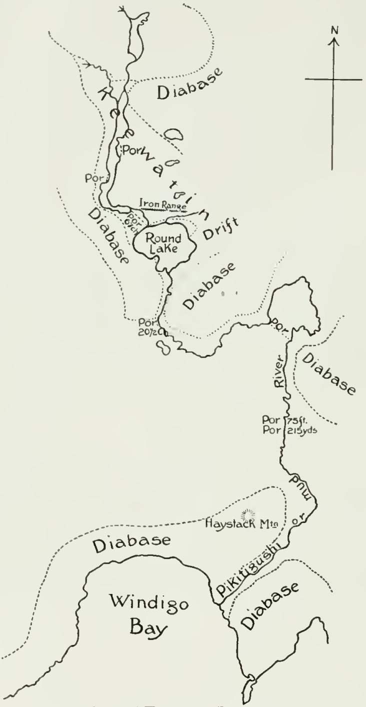
Both above and below this portage the high sand and silt terraces are common, and they continue pretty regularly to the fourth portage, above which they are inconspicuous. In the lower portions of the river banks there is well stratified clay with stratified silt and sand above.

The object of this long portage seems to be the escaping of a trip of ten miles, around a great bend in the river. Careful estimation showed a change of only 15 feet in the level of the river, between the upper and lower ends of the portage.

The stream is much swifter between the third and fourth portages than in its lower stretches, but it remains a good stream for canoe navigation. The distance between these portages is approximately eight miles. In this stretch there are excellent examples of clay and sand terraces, and plenty of opportunity to contrast the regularity of stratification and assortment in the glacial lake deposits, with the irregularity of arrangement in the flood-plain deposits of the present river. The flood-plain is restricted to narrow limits, as the stream is doing so much cutting. It has cut down into the shallow water deposits of the old lake, to a depth of 60 to 70 feet.

The fourth portage is one-quarter mile long, and passes a rapid with a difference in level of 50 feet between its foot and head. The rock occurring at this point is Laurentian gneiss with some narrow bands of gray Keewatin schist.

It is about three miles from the fourth portage to Round lake, and there are no high sand terraces to be seen. The clay and silt are not so common as they were farther down stream, and coarse sand, gravel and boulders replace them. In these coarser deposits and in the well-rounded boulders in the vicinity of Round lake, there is evidence that the shore line of the old glacial lake once lay in this region. Above




LAKE NIPIGON

MAP
Showing Position of
IRON RANGE NORTH OF ROUND LAKE
Report by E.S. Moore
1909
Scale; 1 In.=4 Miles

Round lake the drift deposits are irregular, and do not form level plains as they do below the lake and immediately around it.

Below Round lake the banks of the Mud river are thickly wooded with spruce and cedar, and where the land is high, white birch, poplar and jackpine are common. The timber is, as a rule, small. North and west of the lake the land has been burned very bare, and the country presents a very desolate appearance, while east of the lake there is a sand plain covered with fine jack-pine.

### Rocks of the Round Lake District

In the vicinity of Round lake there are four geological systems, represented by different types of rocks. These are:

Pleistocene—Drift and lacustrine deposits.

Keweenawan—Diabase.

Laurentian—Granite and gneiss.

Keewatin—Greenstone, green schist, fine-grained quartzose gneiss, and Iron formation.

The Mud river district is predominantly a Laurentian area, but, by referring to the small map accompanying this Report, it will be seen that an area of Keewatin rocks occurs north of Round lake. This area stretches about five miles directly north of the lake, where it is cut off by Laurentian granite. It extends only a short distance west of the river, and is then intruded and cut off by diabase, though, from information received regarding the Caribou Lake region, this band of Keewatin appears again beyond the large diabase outcrop. It is not probable that these rocks extend far eastward, because outcrops of diabase north and south of them converge toward the point where they pass under the drift and no doubt cut them off in this direction. The strike of this Keewatin band is about 100°, and it lies nipped in between the great bands of Laurentian granite and gneiss to the north and south.

Both the Laurentian and the Keewatin rocks are overlain and broken through by sheets and irregular masses of diabase.

#### Keewatin Greenstones and Green Schists

These are rocks similar to those in other Keewatin regions. There is, however, a scarcity of acid eruptives of the quartz-porphyry type so common in the Onaman Iron Range region, and less common in the Sturgeon River district. Many of the greenstones show remarkably well developed pillow-structure, which is evidence of their extrusive nature. Besides these extensive greenstones there are many hornblende-porphyries and some diorites, which have a comparatively fresh appearance for Keewatin greenstones, and they may be of later age, although they were not found cutting the Iron formation or the Laurentian rocks. There are diorites in the Lake Wendigokan region whose age cannot be definitely fixed, and which also look comparatively fresh for Keewatin greenstones. Two diorite dikes have been found cutting the Iron formation in the Onaman Iron Range region, showing that the diorite is at least younger than the Iron formation.

A thin section of one of these diorites, from the Round lake district, was examined. About five-sixths of it was composed of blue-green hornblende, in most cases pretty fresh, but in some spots passing over into calcite. The feldspars generally had the composition of andesine, and some of the crystals were much saussuritized, giving rise to zoisite, kaolin and fresh feldspar. The weathered crystals were probably of a more calcic type than the unweathered forms, since the calcic feldspars are, as a rule, less stable than the sodic members of the series, and most readily give rise to saussurite.

There are some green schists developed from the greenstones by regional metamorphism, and there are some chloritic schists whose origin is uncertain, associated

with the Iron formation. There are also quartzose, gneissic schists which seem to resemble some of the Couchiching gneisses of the west, associated with the Iron formation. They are doubtless a phase of a clastic sediment metamorphosed, or they may be a combination of a cherty chemical sediment and a clastic sediment, which have suffered metamorphism. No thin sections of these rocks were examined.

#### The Iron Formation

About one-third of a mile north of Round lake some narrow bands of lean Iron formation occur. The length of the range is only about a mile, and its width is very indefinite. It occurs in a chloritic or gray, gneissic schist, and only shows in a few places where it outcrops in drift, which is very heavy in this region. Bands of magnetite and silica, from eight inches to as many feet in width, occur, but they gradually grade out into a fine-grained gray gneiss, or into schist containing much silica and

Transporting materials for Transcontinental railway.

chlorite, and in some cases stained with oxidized pyrite. One cannot always find the contact between these rocks and the massive greenstones, but the Iron range rocks do not lie in contact with the greenstones. They grade through a thin series of sediments and schists toward the greenstone, and the contacts are usually covered by drift.

The typical Iron formation rock is composed of a crystallized chert interbanded with magnetite and hematite, and containing small amounts of siderite. The magnetite is present in sufficient quantity to affect, very locally, the compass to a considerable extent. The silica has a saccharoidal appearance, and is similar to that which occurs near Trap lake in the Sturgeon River region, or near eruptives in the regions where contact metamorphic action has occurred. It differs from these contact phases, however, in not possessing any actinolite, so far as the specimens collected would indicate. The relation of the silica and iron oxide bands to one another is very irregular, and strongly resembles what one would expect if one of the large cake-like concretions,

common in bog ore regions, were drawn out under great pressure. There is no evidence, however, of clastic quartz such as one finds in the bog ore concretions.

A thin section of this silicious magnetite rock shows that a chert has completely crystallized into interlocking quartz grains, often six-sided. As to the cause of this alteration in the chert, there are several agencies which might produce it. It might be due to the action of the Keweenawan diabase, which seems to have covered this whole region, or to that of the hornblende-porphyrites, or diorites, which are common in the vicinity of the Iron formation, and which may be, as already suggested, younger than the Iron formation, although there is no proof of their younger age. The action might be due to regional metamorphism, or to the existence of Laurentian granite, within half a mile of the Iron formation. The presence of the granite is a very probable factor, because considerable pyrite occurs in some of the schists associated with the Iron formation, as it does in some of the Iron formation rocks intruded by granite in other regions.

The strike of the formation is 100° and the dip is vertical or at a high angle to the north. According to W. H. Collins, a narrow band of Iron formation occurs on the shore of Caribou lake, and it seems probable that it is a continuation of the small band on Round lake.

Mr. McInnes in his notes on the Pikitigushi (Mud) river mentioned the finding of good Iron formation boulders in the drift of the Round Lake region, without any evidence of their origin.[2] He has regarded the Keewatin area as Huronian, which classification is in accordance with the nomenclature in vogue at the time of his visit.

#### The Laurentian Granite and Gneiss

The Laurentian granite and gneiss are the predominant rocks of the region north of lake Nipigon. They are to a large extent excluded from view by the drift and in places by the diabase sheets, but they outcrop in many places, thus showing their widespread distribution.

In the vicinity of Round lake, granite occurs near the northeast corner of the lake and there is a small outcrop along the north shore. It is prominent southwest of the first portage on the Mud river, above Round lake, and the upper part of the portage follows near the contact between the Laurentian granite and Keewatin greenstone. Granite is again seen over large areas beyond the great diabase outcrop along the west side of Mud river, and it occurs about nine miles north of Round lake.

There was nothing striking about these rocks, as they possessed the monotonous characters common to the great Laurentian areas.

#### The Keweenawan Diabases

The Keweenawan system of rocks has been well developed in the Round Lake region, but it is now only represented by remnants of intrusive sheets or batholiths. There is a ridge of hills, conspicuously rounded and irregular, running along the west side of Mud river from a short distance south of Round lake, to beyond the Height of Land to the north, and a similar ridge extends along the east side of the stream but a little farther removed from it. The exterior west and east borders of these respective masses have not been traced out, but the band on the west side of the river is not very wide.

The exact form of these diabase masses has not been determined, but the occurrence along the west side of Round lake seems to be a great, irregular, intrusive mass, which has broken through the older rocks and which probably supplied a course for the material of which the sheets of the region were composed. The base of this mass could not be found, and it seemed to cut, rather than overlie, the older rocks. On the eastern

[2] Can. Geo. Sur., Vol. 15, pp. 211-13A.

side of the lake the mass seemed to be the remnant of a great intrusive sheet, which was injected into rocks now eroded away.

An observation of the diabase outcrops of this region gives one an idea of the tremendous extent of the volcanic activity during Keweenawan time, and of the great quantity of basic igneous rock which has been eroded away since that period. No sediments of Keweenawan age were observed.

#### Pleistocene Geology

The drift in the vicinity of Round lake is heavy in places. There is no distinct beach line in the neighborhood, but there are evidences that the north shore of the old glacial lake, which covered the Nipigon region was not far from Round lake. These evidences are found (1) in the gradual lowering of the sand terraces as one

A column of diabase, Lake Nipigon.

approaches the lake from the south, by way of the river; (2) in the increase in the proportion of coarse clastics, such as boulders, gravel and coarse sand, and the decrease in clay and silt; (3) in the well-rounded boulders found in the vicinity, which are too large and well-rounded to have been worn by the present lake, and (4) in the irregular morainic hills occurring north of Round lake. These hills show no evidence of having been worked over by the glacial lake.

The fact that no distinct beach remains, may be due to the ice acting on the north shore in this region as it has undoubtedly done in the Red Paint region. As Round lake has an elevation of approximately 977 feet above sea level and 125 feet above lake Nipigon, the glacial lake level was a little above this. As the writer has previously pointed out in another article, there seems to be some difference of opinion as to whether this glacial lake was Lake Warren or Lake Algonquin. According to the latest work of Goldthwait, the latter is the only one possible.

Between the third and fourth portages on the Mud river, there are first-rate examples of stratified clay grading upward into the silt and sand. These are the shallow water deposits of the glacial lake, and the river has cut through them to a depth of 60 feet. Along the stream the contrast between the lacustrine deposits and the

flood-plain deposits of the present river is well illustrated. The former are well assorted and perfectly stratified; the latter are characterized by ill assortment of materials, by very irregular stratification and cross-bedding, and by red colors in places. The color occurs in patches of coarse sand, where small pools in the flood-plain have become separated from the main stream, and have been left to evaporate

"Haystack Mountain," from Lake Nipigon.

View showing fractured condition of "Haystack Mountain" on southeast side.

and to deposit their salts of iron, as in a bog. Some of this sand is quite red and the grains carry a coating of limonite.

As an example of the vertical distribution of the drift, it is interesting to note that Laurentian granite boulders were found on the top of "Haystack Mountain," which rises 414 feet above the level of lake Nipigon.

### "Haystack Mountain".

"Haystack Mountain" is a large diabase hill of conical shape resembling at a distance an old volcano. It is not, however, a volcano, and on account of its peculiar shape it has locally been given the above name, "Haystack Mountain." It is situated about three miles north of lake Nipigon, but since it rises like an island in a large swamp, it is most easily reached by going up to the Mud river to the Transcontinental railway line and following the latter two and one-half miles west. The hill lies close to the line.

A half day was spent in investigating this hill, because some prospectors' claims had been staked around it. These claims were staked on account of a local deflection of the compass which prospectors and railway surveyors had observed in the vicinity of the hill. They supposed that it contained a large mass of magnetite.

The hill is, according to a careful barometric measurement, 342 feet higher than the swamp around it, and 414 feet above lake Nipigon. The latter determination was made from bench marks on the railway line. The conical shape seen at a distance is due to a great talus pile on the southeast side. This talus is a very striking feature of the hill, as brecciation begins at the foot and extends to the very summit. Many of the blocks close to the top are huge masses, and it seems strange that such a comparatively small hill should suffer such extensive brecciation. This extreme brecciation seems to be largely limited to the southeast side, as the other sides are without much talus and have steep to comparatively gentle slopes. The only explanation of the conditions which seems to be satisfactory, is to suppose that a fault occurred in comparatively recent time, with a strike nearly northeast and southwest. This would leave a steep fault scarp along the southeast side, and permit the rapid destruction, by weathering agencies, of that part of the hill. The hill is evidently a remnant of a large sheet, the remains of which can be seen in many places over this portion of the country, but the general shape and nature of the mass suggest that it may have been a sort of plug which served as a channel for the ascension of the diabase magma forming the sheet. The fact that there are two other hills somewhat similar to "Haystack Mountain" but of smaller size, lying in line with it, about a mile and a mile and a half respectively to the southeast, suggests that these three hills may be of similar origin, and that the three plug-like masses arose along some line of weakness in the pre-Keweenawan rocks.

The rock in this hill is a diabase similar to that in the Poplar Lodge region, and varies from fine to very coarse grain. There is no iron of importance associated with it, but there are little bunches of titaniferous magnetite or ilmenite occurring as segregations in the coarser diabase. It could not be noticed that the segregations were confined to any particular portion of the hill, but they seemed to be scattered all through it, as they are in other portions of the Keweenawan diabase.

The diabase is cut by small dikes from half an inch to a foot in width. These are of a crypto-crystalline rock resembling fine-grained granite, and are similar to those frequently occurring in the Nipigon region which Dr. A. P. Coleman has identified, from the thin section, as granite. In some cases these dikes are without very distinct boundaries, and since they occur on Flat Rock portage between Lake Nipigon and Nipigon river, filling cracks in a columnar-jointed sheet of diabase, and associated with small pegmatite veins, the writer regards them as an acid phase of the diabase magma, and of a pegmatitic nature

---

# BLACK STURGEON IRON REGION

By A P COLEMAN

A number of iron locations were taken up years ago southwest of lake Nipigon in the neighborhood of Black Sturgeon lake and river, and a certain amount of work was done on them in the way of stripping and diamond drilling. As some very high grade hematite has come from this region, it was of interest to have its geology worked out and mapped. In undertaking this work great assistance has been given by Messrs. Wiley and Marks of Port Arthur, who took up many of the locations and did most of the development work. They were good enough to provide copies of maps and plans of the locations showing where work had been done, and also rough maps of routes by which to go into the region.

Black Sturgeon lake may be reached from three directions; from a point near Wolf on the Canadian Pacific railway, canoes starting under the railway bridge and going up Black Sturgeon river to the lake of the same name; by going part way up Nipigon river and crossing westwards along a chain of lakes, of which Fraser lake is the largest; and by going up Nipigon river to lake Nipigon, then turning westward to Black Sturgeon bay from which there is a canoe route south to Black Sturgeon lake. The route up Black Sturgeon river was chosen as the shortest, though it seems to be seldom used and we could get little information regarding it.

## The Black Sturgeon River

Although this river and the lakes between it and lake Nipigon have been traversed several times, by Dr. Bell,[1] Dr. A. W. G. Wilson,[2] and others, the accounts given of it in the Geological Survey reports are very brief and without details, so that the characteristic features, topographical and geological, will be given here.

Our canoes were put in the water beneath the railway bridge, a mile or two from Black bay of lake Superior and, according to White's Altitudes, ten feet above it. At this point the river flows between banks of stratified clay at the bottom, and sand above, having cut its channel down through about 55 feet of old delta deposits. Two or three miles up there is a rapid, where the portage path climbs to the top of the terrace, which it follows for a fifth of a mile. The fall here is about 14 feet. Three quarters of a mile up stream there is a second portage over a low terrace, rising 20 feet from the river; followed after 200 or 300 yards of paddling by a third short portage; and half a mile farther up, by a fourth, only 100 yards long. The first portage is on the east side, the others on the west; and the total rise is to 643 feet (aneroid). No rock is seen until a bend in the river two or three miles above the fourth portage, stratified clay covered by stratified sand making the banks, which reach the level of the main terrace at about 667 feet. Here a cliff of red granite and gray gneiss rises about 200 feet on the east side of the river, with a talus of great blocks at its base.

About two miles above the cliff, following the windings of the stream, there is a fifth portage, 100 yards long, on the west side over red Keweenawan shale; followed a mile beyond by the sixth portage, on the east side over boulders. An excursion inland to the west of one of the bends showed a low sill of diabase about 60 feet above the river, followed by talus and a cliff, the lower part of Keweenawan stratified rock lying nearly horizontal and rising 300 feet above the sill, the upper part of roughly columnar diabase having a height of at least 200 feet.

The red shaly rock between the diabase sheets turns to gray as it comes against the upper diabase, and is finely laminated in places, pale gray and dark gray or red;

[1] G. S. C., 1866-9, pp. 333-4; 1872-3, pp. 97-8. [2] Ibid, 1901. 97A and 101A to 103A.

while in others there are ripplemarks, mud cracks, and cross-bedding on a small scale. From a distance the cliffs are bright or dark red in the lower part with the gray diabase above.

In general, the river swings to and fro across its valley, which is about three-quarters of a mile wide, between cliffs of granite and gneiss to the east and Keweenawan rocks to the west, presenting very striking scenery. The valley has either been eroded out of the Keweenawan where it leaned up against a pre-Keweenawan cliff; or represents a much widened fault zone where the western side has slipped down as compared with the eastern. The former theory seems on the whole the more probable.

Beyond this on the way up stream the valley widens, and in a few miles the diabase cliffs to the west are miles away, while the hills of granite and gneiss continue their course not far to the east, though never actually reaching the river. There are a few terraces with clay beneath and sand above, reaching an elevation of 700 or 710 feet above the sea. The current is stiff with riffles or small rapids requiring the pole or rope in places for about 20 miles above the sixth portage, before the seventh

Diabase cliffs, Black Sturgeon river.

portage is reached, 150 yards long on the east side, over a sand terrace, past a rapid with a fall of ten feet over boulders. Not far above this portage another, on the west side, with a length of about a quarter of a mile cuts off a bend of the river, avoiding an almost continuous series of rapids with a total fall of about 20 feet. Soon after Little Nonwatin or Nonwatinose lake, about two miles long, opens out, with marshy shores. Three miles of river and another rapid with a fall of ten feet, bring one to the level of Nonwatin lake, the portage being on the east side and about 250 paces long.

### Nonwatin Lake

Before reaching Nonwatin a lake expansion more than a mile long from southeast to northwest, and about a mile of river with low marshy shores must be passed. Nonwatin itself is roughly square in outline, three miles long from southwest to northeast, and two miles from the stretch of river just mentioned northwestwards to the continuation of Black Sturgeon river. Its shores are low, but there is a high range

of rocky hills half a mile to the east and north. To the west and south the hills are distant and comparatively low. The bold escarpments of the Keweenawan diabase sheets, so striking a few miles down the river, are wanting, or are so distant as to attract no attention. According to railway surveys, lake Nonwatin is 759 feet above the sea or 159 feet above lake Superior. Points on its shore are definitely fixed by two base lines, one east and west, and the other north and south. Beatty's east and west line cuts Black Sturgeon river at 9 miles 38½ chains from its starting point to the east, and strikes the southeast end of the lake about a half mile to the west. On the other side the 12-mile post is a few hundred yards west of the southwest bay of Nonwatin lake.

Beside Black Sturgeon river coming in from the lake of the same name on the northwest, another large stream, Nonwatin river, comes in from the west, with many windings through low ground.

The iron locations touch Nonwatin lake at its northeast corner and extend southeastward nearly to Beatty's line, and northwestward to Black Sturgeon lake. Some of the lines are old and by no means easy to follow; but the later ones are well cut out and present no difficulty except in swampy places. Most of the locations have been so chosen as to include the southwestward cliffs of the range of granite hills, and the lines often require a stiff climb of several hundred feet from the drift-covered low ground along the lake to the summit of the Laurentian ridge.

### Geology of the Nonwatin Region

It was soon found that no Iron formation of Keewatin age and character existed in the region, the lower ground consisting of drift with a few outcrops of Keweenawan sediments or diabase, and the range of hills of granite, gneiss and certain schists. The iron ore occurs always along or near the southwestern flank of the Laurentian hills, mainly in small fissures.

Beginning at the southeast at Beatty's line, which runs about a quarter of a mile to the south of the last claim, the geology may be followed to the northwest. Along Beatty's line eastward from the lake only boulder clay is seen for a third of a mile, when a slope of much weathered diabase rises toward the east and continues to mile IX., after which drift covers the rock again for 620 paces, with granite rising here and there through the mantle of boulder clay. At three-eighths of a mile east of mile IX. there is a cliff of gray schist, either Laurentian or Keewatin, capped by a sheet of diabase, and on the cliff there are a few red streaks suggesting hematite, but nothing that could be called ore.

The sheet of diabase extends for several hundred yards to the east and forms the highest summits of the ridge at this point, reaching 730 feet above Nonwatin lake, or 1,490 feet above sea level. To the north it breaks off as a steep cliff, under which granite is found, 235 feet below the top of the hill, showing that the diabase sheet has at least this thickness.

On locations G 711, G 712, and G 713 the overlying diabase sheet was not fóund, the top of the broad ridge consisting of granite, gneiss and gray schist, the last rock being most common. Toward the southwest corners of G 711 and G 713 the ridge descends steeply toward the lowland and a few thin seams of red hematite or black specular hematite occur on the edge of the slope. In one place on the south side of G 713 a coarse breccia of granite fragments with a little hematite is found, as if the granite had been shattered on a talus slope before the small stringers of ore were formed. It may, however, be a fault breccia.

At the foot of the cliff talus blocks of recent age hide the rock, and boulder clay forms the lower slopes, but within one or two hundred yards low swells of Keweenawan rock occur, in one place near the southwest corner of G 713 red shaly limestone, in others diabase.

There is a gap of a quarter of a mile between the northwest corner of G 711 and A.L. 6, the rocks along the tie line connecting the two locations being Laurentian where not covered with drift. A.L. 6, includes only Laurentian granite and gray schist, so far as the east and north side are concerned, but the southwest corner sinks down under drift deposits, broken by a low outcrop of diabase just south of the corner post.

A.L. 9 also displays chiefly gray gneiss or schist somewhat cut by granite, and penetrated toward the northwest corner by a broad dike of diabase. The southwest corner consists of reddish or gray shaly limestone or marl overlain towards the foot of the Laurentian hill by a thin sheet of reddish fine-grained sandstone. In places coarse diabase, and also what appear to be dikes of much decayed felsite, occur in it, but the outcrops are low and often covered with boulder clay, so that the relations are obscure.

G. 709, touching the northeast bay of lake Nonwatin, is mainly covered with boulder clay, though its northeast side rises upon the Archean ridge to a height of 1,300 feet with fine cliffs of the usual granite and gray schist. The only rock found below the steep hill slope is a low outcrop of much weathered diabase an eighth of a mile from the northwest corner post. No rock was seen on G. 710, only low hills and swampy flats covered with boulder clay and an esker ridge or two, but angular fragments of red shale or marl on some of the hill slopes probably indicate Keweenawan rocks not far below the surface. This location is the only one near the lake which does not rise upon the Archean ridge.

G 708 also is mostly drift-covered, the only rock observed being on the ridge of granite and gray schist at the extreme northeast corner. Descending a precipice 300 feet high toward the west the northern boundary crosses a stream and immediately rises more than 150 feet to the crest of a moraine which runs northwest into G 707 parallel to the Archean hills. Granite and gray schist rise steeply along the eastern and northern sides of G 707 and continue into G 706 and G 705, occupying the northeast corners of these two locations, the rest being covered mainly with boulder clay.

It is evident that the locations northwest of A.L. 6 have been taken up along the edge of the Archean hills so as to include the slope to the southwest, where in many places red Keweenawan rocks occur at the base of the cliffs. As no ore was found by us along this hillside for the three miles of outcrop northeast and north of lake Nonwatin, it may be that the red Keweenawan marl, etc., was looked on as indicating ore; or the claims may simply have been intended to connect up the southeastern outcrops containing a little hematite with the more promising ones toward the northwest.

### Along Black Sturgeon River

Along Black Sturgeon river between Nonwatin and Black Sturgeon lakes there are considerable exposures of red shale or marl belonging to the Keweenawan, the longest continuous outcrop of the sort being on its banks toward the eastern end. The shale rises from 8 to 15 or 20 feet above the river as red cliffs rapidly crumbling under the weather; so much so that a hand specimen is hard to get. The weathered surfaces show the horizontal stratification better than unweathered ones, and occasionally ripple marks may be seen. The rock is surprisingly fresh looking and, so far as appearance goes, might be of any age up to recent times, though the general relationships in the region make its age almost certainly Keweenawan. The red shale may be followed up stream for more than two miles, when it is covered by drift. The thickness of the shale is undetermined and it has not been found in contact with any other rock, though the diabase found at some of the rapids above is probably part of an overlying sheet.

South of the river boulder clay and morainic ridges completely cover the bed rock so far as our work extended; and the same is true to the north for about a mile, though angular fragments of red shale occur here and there where trees have

Laurentian hills, Black Sturgeon river.

Canyon near Black Sturgeon river.

been overturned, showing that the bed continues not far below the surface. As red shale in the form of sand and gravel occurs along the shore of Nonwatin lake at many places, one may conclude that its bed is made of this material, which probably underlies the gray shale, soft sandstone or diabase found outcropping in many parts of the low ground southwest of the range of Archean hills.

The upper part of the river, west of the two miles of rapids where the shale is cut into, flows mainly between shores of morainic materials, but a low sill of diabase with blocks which have been somewhat shifted, forms the short island portage between two small lake expansions.

Parts of the shore of the river may fairly be described as of wood, for cedar swamps full of fallen trunks scarcely decayed have encroached on the river bed; so that in places one can walk 50 yards out on the tangle of logs and branches with small arms of the river flowing through or beneath them.

### Iron Locations Between Nonwatin and Sturgeon Lakes

Most of the region northeast of the river as far as the top of the Archean hills has been blocked out into locations, several of those in the lowland showing, however, nothing but morainic deposits where not covered with muskegs.

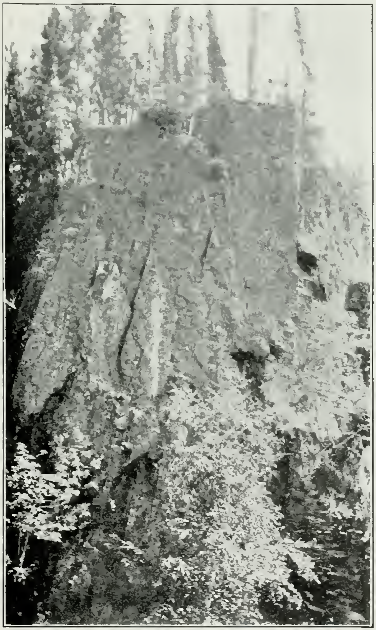
In a former paragraph location G 705 was referred to as including the edge of the hill at its northeast corner; but in the succeeding locations to the west, G 704-3-2 and 1 no rock whatever was found. They were apparently taken up with the idea that iron-bearing rocks might underlie the drift, the red shale found here and there in the boulder clay giving a suggestion of this sort.

North of this row of locations there are much older ones, with lines now hard to follow, so laid out as to take in the front of the Archean hills, A.L. 4, 2, 3 and 5. A.L. 1, however, is on lower ground, where only glacial materials were seen by us. Toward the eastern end of A.L. 4 the edge of the hill is of the kind frequently referred to before, with little suggestion of ore, but toward the west the crest of the steep hill shows red stains on the Laurentian rocks and a few thin seams of hematite connected with a breccia of Laurentian materials. A hundred yards west, in location A.L. 2, a singular ravine or narrow canyon opens up between walls of Archean rock, running first about north for an eighth of a mile, then turning off to the northwest. The walls are of granite, often vertical and in places more than 100 feet high. At one point gray schist has tumbled in from the top, partly filling the canyon, the tiny creek flowing under the loose rocks. The cause of this curious vertically walled ravine is not easy to assign, since the present creek is insignificant and does no appreciable work. The canyon may be pre-Keweenawan in age. Near its mouth and for some distance along the cliff on each side red stains and small seams of ore occur, and at the bottom in some places there are irregular veins of jasper and brecciated granite, often quite pretty with different tones of red. Concretionary masses of chalcedony without iron oxide occur also. The amount of ore observed is small near the mouth of the canyon, and none is seen farther up.

Slight seams of hematite and some breccia and jasper are found westwards along the edge of the cliffs of granite and gray schist through A.L. 3 and the north side of A.L. 5. Here another ravine, on a smaller scale, penetrates the front of the hill, but runs only a short distance in. The rocks found along the bed of a small creek which cascades down the ravine for about 200 feet are greatly weathered and hard to interpret. They look like red and gray shale, steeply tilted to the south so as to rest against the Archean hill side of granite, but are probably much decomposed gray schist of Archean age. They seem to have been shattered, brecciated or even crushed to material like arkose before the hematite was deposited, since this fills fissures and encloses fragments of the crushed rocks. The edge of the cliff may really be a very ancient zone

of faulting, where waters charged with iron compounds from overlying Keweenawan rocks could deposit their contents. Since then the removal of the Keweenawan has exposed the once buried fault zone. It is possible, however, that it was a pre-Keweenawan cliff, weathered and frost shattered before the Keweenawan sediments were laid down.

Besides the canyon-like ravines mentioned above there is an even more striking one cutting the Archean tableland a quarter of a mile north of A.L. 4. Following the



Cliff in Canyon near Black Sturgeon river.

north and south base line one rises upon the usual surface of granite with some gray schist, with an elevation of 1,100 to 1,160 feet above sea level. A little south of mile 4 on the base line the canyon opens suddenly with vertical walls a hundred feet deep. At the bottom there is only a trickle of water making its way through heaps of talus. The width of the canyon is less than 100 paces, and the north side rises as precipitously as the other to a height of more than 1,200 feet. The direction of this valley

is about northwest and southeast. These is no observable cause for the sudden and sharp depression in the tableland, no remnant of diabase visible to suggest the weathering out of a dike, no softer layer of vertical schist that could be easily destroyed, and no hint of a former river or succession of water falls capable of carving such a narrow and steep walled ravine.

South of the Archean cliff at the west end of A.L. 5 there is a small lake with a sharp moraine ridge beyond it, a narrow ravine, and then a second parallel moraine, running for perhaps a mile from east to west. On the southern lake shore there are large angular blocks of sandstone, but this rock was not seen in place, being buried under the drift.

The continuation of the edge of the Archean tableland strikes to the west beyond this, passing through locations G 698, 697 and 695 without much change in character, but at some points on its flanks diabase is found; and farther to the south in G 700 and G 699 Keweenawan sediments occur, partly drift-covered, a yellowish dolomitic rock along the north of the locations, and red shale and breccia about midway in them. East and west of the boundary between G 699 and G 695 streaks and seams of hematite occur along the Archean slope, as at so many other points. No rock was observed on G 696, which extends southward from G 695 to Black Sturgeon river.

### Locations Southeast of Black Sturgeon Lake

Locations G 694 and 693 occupy low ground covered with swamp and drift near Black Sturgeon lake, but the line of outcrop of the Archean hills crosses the northeast side of 200 E. and runs from south to north in 97 E., partly as rather steep slopes and cliffs, but toward the north sinking to lower, drift-covered slopes. To the southwest of the cliff in some places diabase appears on the lower slope; while the cliff itself consists of red granite or gray schist, or a mixture of the two rocks. Near the middle of 200 E a small ravine opens in the Archean hills running northeast and occupied by a small creek. Very similar relationships to those described before occur here, rusty and much weathered rocks, looking like sandstone or sandy shale, being found at the foot of the ravine as if piled up against the Archean, but showing all transitions to the gray schist penetrated by granite dikes which makes the top of the tableland. The weathered front of the cliff has almost lost its original character and is seamed and streaked with hematite, red or micaceous. The small granite dikes in this weathered zone have been brecciated, sometimes taking on the character of arkose, a little chalcedony forming part of the cement.

No important amount of ore occurs, though the reddened rock bulks quite largely.

Following the outcrop of Archean northwards through 97 E, the extent of the weathered material diminishes and it sometimes almost disappears, the gray schist looking quite fresh, and having a strike of east and west with about vertical dip. The granite is generally more weathered, broken surfaces showing the feldspar mostly changed to decomposition products. Among the finer grained granites and schists, there are some very coarse pegmatitic parts, almost white where not weathered.

The face of the cliff turns toward the northwest near the northern end of 97 E and is less precipitous, sinking to a gentle slope at the northwest corner of the location, where boulder clay covers most of the rock.

#### Location 94 E

The most interesting seams of ore in the region are found on location 94 E, where a good deal of stripping and diamond drilling have been done, and several log houses have been built. At the southwest corner of the location a shallow pond named Beaver Dam lake hides the rock, but just to the south a low escarpment of diabase rises as a cliff and continues westward into G 692. To the north of the pond another canyon cuts into the Archean rocks, running very straight in the direction N. 55° E., with

steep walls, often unscaleable, reaching a height of 200 feet or more above the floor. In many places great heaps of talus have rolled down, giving a V-shaped bottom to the ravine. At the time of our visit there was no stream flowing in the canyon, but strong springs rising from broken rock near the pond no doubt represent an underground drainage.

Trenching along the foot of the cliff near the mouth of the canyon begins in 95 E and runs into 94 E, having a direction of about northwest and southeast, and a length of about 60 paces. It shows mainly gray green slate or schist as country rock, standing vertical and having a strike of 55° or 60°. The rock north of the pond is greatly crushed and slickensided in places, showing evidence of faulting, as suggested by Mr. Knobel, who studied the geology of the region for the owners of the locations. There is a good deal of rusty, greatly decomposed, rock near the mouth of the canyon, especially just to the east of it, with seams of pure hematite; micaceous or botryoidal in places, and also of reddish black martite with very perfect octahedral cleavage, evi-

Indian Children, Height of Land portage, Pic river.

dently pseudo-morphous after magnetite. The ore occupies narrow fissures between the small blocks of the crush breccia, and frequently the same octahedral cleavage runs for several inches, quite enclosing bits of the rusty country rock. We have then here soft red hematite, black micaceous or specular hematite, botryoidal concretionary coatings of hematite, and also martite. Small veins or fragments of the ore may be selected which are practically pure, but the total amount to be seen is only small. The ore is of admirable quality if it occurred in amounts to make it of economic importance. Very few other minerals were seen, though a little calcite occurs with the ore in small cavities.

Going up the canyon a little of the red rock with films of ore is found for 480 paces, mostly on the face of the cliff to the northwest.

The walls of the canyon correspond in direction to the strike of the schist and consist of that rock for nearly a mile northeast of the pond, when diabase takes the place of schist, and the sharply defined character of the ravine gives way to a less regular depression. The relation of the diabase to the schist is not quite certain, though it is, of course, later, and grows finer grained at the contact. Small outcrops of diabase

were found by Mr. Moore towards the northeast end at the bottom of the canyon between walls of schist, suggesting that the ravine may have been due to the weathering out of a dike. If so, the dike materials seem to have been very effectively buried under talus blocks of schist or slate at the southwest end; however, no other theory of the origin of the canyon seems as probable as this. The main mass of diabase to the northeast seems to be an irregular sheet overlying the Archean.

The schist varies a good deal, some parts resembling slate and others being spotted with small patches of white or red. It has the appearance of a true Keewatin rock rather than of the Couchiching phase found in some other parts of the region.

In various directions within a mile or two granitic and gneissoid rocks are found, so that the area of distinct Keewatin schist is not large, and owing to the invasion of dikes and bosses of granite, is hard to define on a map.

Beaver Dam lake stands at 940 feet, while the highest point along the walls of the canyon, half a mile up, was found to be 1,230 feet. Close to the north end of the pond a test-pit shows loose blocks of red shale and sandstone, probably not far from their source, so that Keweenawan sediments probably underlie the pond and the diabase sheet which rises as a cliff 20 feet high at the other end.

### 95 E and 96 E

Following an old line nearly obliterated running east from the canyon near where the east side of 94 E reaches the cliff, the Keewatin gray schist is found for half a mile, when a hill of diabase rises to 1,270 feet, no doubt overlying the Archean. Going south on the eastern line of the old location (R 409) granite and schist are encountered, and the same is true of the line on the south side of this old location.

These old lines are very hard to follow, and the fresh lines of the new locations have been placed with no relation to them.

Going northwest from the mouth of the canyon just described the Archean hill side may be followed through 95 E into 96 E without much appearance of ore, partly perhaps because of the large amount of drift covering the slope, which is here not very steep. A few hundred yards within 96 E rusty surfaces and thin seams of ore occur, and then a wide expanse of rusty rock where a comparatively large amount of work has been done in the way of pits, trenches, and diamond drilling. Much of the lower surface is covered with sandy till, which has been stripped in places, disclosing the rusty rock beneath. One or two of the pits sunk through the till, though timbered, have been partly filled with sand, so that little is to be seen in them. The bed rock appears to be brecciated coarse granite, much reddened with hematite, but seldom heavy enough to be called ore. The dumps consisting of this material show slickensided surfaces, and thin films of black hematite with a little dull jasper. Near one pit part way up the hill side a little very lean ore occurs with the usual rusty rock.

The hill to the east of the pits has been more or less trenched and stripped, showing first minute ore seams and rusty granite, and then reddish black much weathered slate or schist passing into fresh gray green Keewatin schist, with a dip varying from 80° to vertical and a strike of 60° to 80°. Even in the freshest schist near the hill top a few narrow seams of reddened material or films of hematite show that the ore-bearing solutions have acted on the rock, the solutions probably coming from overlying Keweenawan rocks now removed. The rusty area in 96 E is the largest seen in the region, though no really valuable ore is disclosed in the dumps. A little of the very cleavable martite described before is found in the brecciated rock, but less than in one of the test pits near Beaver Dam lake in 94 E.

Along the hill side northwest toward the eastern line of A.L. 7 a few ore seams are found, mainly in Keewatin schist, but these disappear soon, and before the west boundary is reached the hill slope is no longer well marked. Farther to the northwest morainic ridges and hills seem to hide the rock completely.

The locations to the southwest of those along this part of the escarpment show hilly surfaces of sand silt and boulder clay, with some sharp esker ridges and several kettle basins, either empty or enclosing a small lake. Still to the southeast, across the Black Sturgeon river broad moraines rise with steep stony slopes and extend for some distance. No rock was found in that quarter and no location lines were to be seen, so that work was not continued in this direction.

Indian mother with pappoose.

### Summary of the Geology

Summing up the geological relationships in the Nonwatin-Black Sturgeon region, we have underlying all an Archean surface of granite, gneiss and gray or green schist, sometimes of a Couchiching aspect, at others typical Keewatin, the schistose rocks being cut by dikes of granite in many places. The flat Archean surface stands at two levels, a lower one, now chiefly hidden under Keweenawan rocks and drift, and an upper one rising from 300 to 500 feet higher and having a somewhat uneven surface,

granite bosses and hills often standing above the areas formed of gneiss and schist. Whether these two levels existed in Archean times or have been separated since by faulting along the northwest and southeast line of escarpment mentioned in the description of the claims, cannot be settled positively, though faulting in Keweenawan or somewhat later times seems probable.

No Archean rocks later than the Keewatin and Laurentian have been found, the whole of the Huronian appearing to be absent, unless possibly some of the overlying sedimentary rocks are of Animikie or Upper Huronian age.

At one time the whole Archean surface seems to have been covered with Keweenawan rocks, though most of the tableland northeast of the escarpment, so far as explored by us, is now free from them.

The rocks generally called Keweenawan include various sediments and diabase. The sediments found in our work are red and gray shale, impure dolomite or limestone, and reddish sandstone, the red shale being the lowest, and much thicker and more widespread than the other rocks. They all appear to lie nearly horizontal and to have suffered practically no distortion or metamorphism, since they are still soft and easily crumble under weathering. In appearance they might be quite recent, but no fossils have been found in them, and the association with diabase sheets like those of the Keweenawan makes it probable that they are of Keweenawan (or Lower Cambrian) age.

The sedimentary rocks have been found only below the step between the lower and higher Archean surfaces, and they often occur in small outcrops just at the foot of the cliff or slope separating the two levels. Their wider extent is shown along the channel of Black Sturgeon river and by the angular fragments of red shale commonly found in the boulder clay. In many places they are covered by a sheet of diabase; and it is pretty certain that the exposed parts of the sedimentary rocks were once protected by an extension of this sheet, now removed by weathering and glacial erosion, since such very fragile rocks as the red shale could hardly have survived the immense period of erosion since Keweenawan times.

No sedimentary rocks of this age have been found by us on the higher level of the Archean, which looks as if this portion was originally higher than the low ground covered with the sediments. In several places diabase is found on the flanks of the escarpment and frequently also on the higher points within the region studied. A northward excursion by Mr. Moore showed that a wide sheet extends towards lake Nipigon from the outcrop crossing the canyon northeast of 94 E.

It is likely that diabase sheets of several ages and levels occur in the region, but our work provided no means of correlating the various outcrops. Large dikes of diabase occur in various places, and it seems probable that the steep-walled narrow canyons in the higher Archean level were caused by the weathering out of dikes of this or some other easily weathered basic eruptive. The canyons sometimes run parallel to the strike of the schistose structure of the Archean, but at least one of them is at right angles to this direction, so that the supposition of softer layers of schist is precluded.

The diabase dikes may show the channels through which the molten material of the sheets or sills rose from below. None of the diabase seen in the region shows amygdaloidal or pillow structure, nor are there any other hints of surface volcanic activity, such as agglomerates or ash rocks; so that the sheets of diabase appear to have been injected between sedimentary layers, or, on the Archean tableland, between the Archean and some overlying sedimentary rock now removed.

The source of the iron solutions which have so widely impregnated the Archean granite and schist at the edge of the escarpment between the two levels, must be

looked for in the Keweenawan sediments, most of which are charged with enough hematite to be red. So far as known, the leaching process went on chiefly along the cliffs or slope of the escarpment, where these rocks lay against the edge of the older rocks. The brecciation of the granite and schist along this line suggests that some faulting took place here after the Keweenawan covered the region, though probably part of the change of level had already taken place before the shale was laid down. The later faulting, affecting both classes of rocks, would give a good opportunity for the leaching of the sediments and the deposit of seams of hematite in the crushed and fissured Archean beneath. The total throw of the fault, or faults, must have been several hundreds of feet; but it is probable that the lower diabase sheet is not simply a continuation of the upper sheet faulted down to its present level, since the lower one seems to be much thinner than the upper one, and more easily weathered.

### The Fraser Lake Region

As iron claims had been reported near Fraser lake between Nonwatin lake and Nipigon river, an expedition was made to the region. The canoe route turns off to the east from Black Sturgeon river a little south of the first rapids below Nonwatin. The portage is well beaten and about one and three-quarter miles long, first over low and swampy ground for a quarter of a mile, then ascending rapidly on a slope of boulder clay followed by outcrops of granite and gray schist, reaching a level of 470 feet above the river or 1,230 feet above the sea half a mile before Magee lake is reached on the other side of the water shed. The trail takes the lowest point in the Archean ridge, which rises 200 feet higher to the north and south. Magee lake is a beautiful body of water 1,106 feet above the sea, as shown by aneroid, with cliffs of diabase on the south and a small outcrop of gray green schist at its east side.

From Magee lake a portage of nearly half a mile leads eastward over low ground to a small pond, from which there is another half mile to the creek draining Magee lake into Fraser lake. A quarter of a mile's paddle brings one to the southern end of Fraser lake. There are no rocks exposed between the two lakes. Fraser lake is six miles long from north to south and nearly two miles wide at the widest place, near the lower end; and is 1,043 feet above sea as shown by aneroid. Its shores are generally low and with few outcrops of rock. On the west side along a low promontory, flat-lying conglomerate and arkose of the Keweenawan rise three or four feet above water, and diabase is seen on the small peninsula to the north and for half a mile along the shore beyond, nowhere rising more than a few feet above water.

The iron claims lie about a mile and a half to the west of the north end of Fraser lake and are best reached through two small lakes tributary to the main lake. We gave the name Oliver to the first lake, which has low shores and, so far as observed, no outcrops of rock. A small creek with very little fall leads into the second lake, which we named Roland. It also has low shore of drift or swamp, though a fine flat-topped hill of diabase rises a quarter of a mile to the west. At the southern end of a narrow bay the first claim begins, and is followed by three others in succession toward the south. On the first claim only drift was seen, while on the second granite with some gray schist is found to the southwest, and a low ridge of gray schist runs north and south about midway across the southern boundary, showing on its slopes a few narrow streaks and seams of hematite. This low escarpment may be followed for about half a mile from the middle of the second claim to the middle of the fourth, more or less of the hematite showing all along, on granite as well as gray schist. In the low ground a little soft sandstone occurs to the west of the escarpment, but most of the surface is covered with bouldery drift.

Toward the southwest end of the third claim there is a low escarpment of diabase, which rises to the south along the west side of the next claim forming an eastward facing cliff. At its bottom gray slate of the Keweenawan is exposed, followed by

Archean gray schist, and then by another diabase escarpment facing west. Between the two diabase escarpments the ground is low.

Evidently the geological relationships and the peculiar little seams of hematite are exactly like those of Nonwatin and Black Sturgeon lakes, except that everything is on a much smaller scale. The amount of ore seen is quite insignificant.

The diabase on and near the claims nowhere rises more than perhaps 75 feet above the general level; but the escarpment a quarter of a mile east of lake Roland is much more impressive, reaching 290 feet above the lake, though the lower third of its front is covered by a talus of large blocks fallen from the cliff. The surface of the diabase is fairly level, and from the edge of the cliff lakes Roland and Oliver as well as Fraser lake and several other smaller bodies of water can be seen toward the east, while a bay of lake Nipigon is visible to the northeast.

Jackfish, the largest 2 feet 11 inches long. This variety common in waters of Nipigon region.

The shores of all the three lakes are largely formed of rounded pebbles or boulders which can hardly have been shaped by the waves of such small bodies of water, and must have been derived from some old lake beach or from unusually well rounded stones out of the glacial deposits.

### Black Sturgeon Lake

Black Sturgeon lake has been briefly described by Dr. Bell[3] and Dr. A. W. G. Wilson,[4] and it is not intended to give details regarding it here, but to refer to the main topographical features observed on the route to lake Nipigon, followed on our way out.

The shore along the claims described on an earlier page begins with a beautiful sweep of sand and gravel beach near the outlet into Black Sturgeon river, the materials partly derived from glacial deposits, and partly from the underlying Keweenawan rocks such as red shale. Toward the northwest the gravel beaches give way to coarser

[3] G. S. C., 1866-69, p. 333. [4] Ibid., 1901, p. 97A.

Going north round the promontory which bounds Black Sturgeon bay toward the west, montonous cliffs of diabase form the shore with a few tiny dikes of later granitic rock. Round the point to the east there are smooth, gently sloping surfaces of

[5] G. S. C., 1866-9, p. 333.

BLACK STURGEON LAKE
IRON DISTRICT
SCALE: 1 MILE-1 INCH.
HON. F. COCHRANE
Minister of Lands, Forests, & Mines.
TO ACCOMPANY REPORT BY
A.P. COLEMAN
IN THE 18TH REPORT OF
THE BUREAU OF MINES
1909.
E.H. HARCOURT C. LIMITED LITHO TORONTO
LEGEND
PLEISTOCENE Drift
KEWEENAWAN Diabase
Shale & Sandstone
KEEWATIN Green Schist
LAURENTIAN Granite Gneiss Gray Schist
Seams of Hematite
Black Sturgeon Lake
Black Sturgeon River
Nonwatin Lake
Nonwatin River
Nonwatinase Lake
L. Roland
L. Oliver
Fraser Lake
Mages L.
Beatty's Base Line
Base Line
Canyon
Camp
Portage
Rapids
Falls
Creek
Road
Trail
N

stones, mainly well rounded cobbles or boulders of diabase, though in places there are angular blocks of red shale, and in others of gray schist or slate, evidently derived from near-by sources.

Similar bouldery shores, mostly of rounded diabase, extend along the south shore of the lake toward the point of entry of Rat Root river, though sand or gravel beaches have been formed in the more sheltered bays. Rat Root river has its outlet deflected to the east for a quarter of a mile by a wall of large boulders, probably transported and built up by lake ice. The shores at the south end of the lake are all low and without exposures of bed rock, though morainic hills 100 or 200 feet high rise toward the southeast.

At the narrows half way up Black Sturgeon lake low shores of granite and gneiss occur on the east side, with rounded hills to the northeast, and at the opposite or southwestern side flat surfaces of coarse diabase pass under the water at the different points, with drift inland. Along the northeast shore there is higher ground with some steep cliffs reaching the lake, apparently of columnar diabase, but circumstances did not permit a visit to them.

The canoe route passes northwest from Black Sturgeon lake into a marshy bay, nearly cut off by a sandy point from the main lake, and then by a quarter of a mile of flat portage over rounded boulders into a pond. From this a portage two-thirds of a mile long, over rounded stones only partially drift-covered, leads to the southwestern bay of lake Nipigon, often called Black Sturgeon bay. The portage rises very little above lake Nipigon, probably not more than ten feet, and the bare boulders along the route with swampy ground to the east suggest an old outlet of lake Nipigon to lake Superior. As Black Sturgeon is 829 feet above the sea and lake Nipigon 850, there would be a fall of 21 feet in the distance of about a mile, sufficient to scour the clay from the boulders in the way now to be seen. Dr. Bell noticed the same relations nearly 40 years ago, and was informed by Indians that formerly in high water there actually was an outflow in that direction.[5] It may be that Nipigon river has been slowly deepening its channel and so has gained the advantage of its western rival outlet.

The south end of Black Sturgeon bay is narrow and river-like with several bends and with much higher ground on each side, the hills being capped with diabase. No solid rock was observed in the abandoned river channel, only large rounded boulders of diabase.

### Black Sturgeon Bay to South Bay

Cruising northeastward along the right shore of Sturgeon bay, Laurentian is seen first as large blocks, then diabase, then Keewatin schist, followed by diabase and once more green schist, with low shores for the first two miles. Then diabase cliffs rise for two miles more with a few small outcrops of Keewatin schist at intervals, almost as if large blocks of Keewatin rocks had been carried off by the molten diabase.

Where the winter portage crosses the long peninsula between Black Sturgeon and Grand bays granite shows itself, and the rest of the low point near by consists of granite, gneiss and bands like Keewatin. In one place a small horizontal sheet of diabase parts two layers of gneiss; and 100 yards to the south there is a cliff of diabase, though the contact between the rocks is hidden. As angular fragments of fine-grained red sandstone and also of what appears to be a basal breccia occur near by, there may be a thin bed of sedimentary rock between the diabase and the Archean.

Going north round the promontory which bounds Black Sturgeon bay toward the west, montonous cliffs of diabase form the shore with a few tiny dikes of later granitic rock. Round the point to the east there are smooth, gently sloping surfaces of

[5] G. S. C., 1866-9, p. 333.

diabase often beautifully ice-scoured, with striae running 65° west of south, and well formed "chatter cracks." The same diabase is met with along the east side of the promontory as far as the portage across a narrow neck of peninsula between the main lake and Grand bay. The portage is over muskeg almost at lake level.

Following along the lakeward side of the peninsula limestone forms the low shore for some distance, sometimes fairly pure, but mostly mixed with serpentine. It is rather crystalline and at times shows a rude eozoön structure. Fine-grained diabase appears to run beneath the limestone where first met, and a quarter of a mile farther east there is a nearly vertical contact between the marble-like limestone and diabase, the two rocks rising as a low cliff. The diabase at this point appears to be a dike, but 200 or 300 yards to the northeast it overlies the limestone and presently only diabase is to be seen.

Bear cubs at Indian camp, Nipigon river.

The limestone may not be very thick—only 20 feet of thickness could be seen at any one place—and its crystalline character is no doubt due to the effects of the neighboring diabase sheets above and below.

Rounding Gros Cap toward the mouth of Grand bay there are high shores and cliffs of diabase with no more sedimentary rocks. The flat top of Gros Cap rises 320 feet (aneroid) above the lake and forms a conspicuous landmark in the southern waters of lake Nipigon. At one point this thick sheet is cut by a nearly vertical dike of finer-grained diabase, which weathers more easily and so makes a canyon-like depression.

Otter head, on the south side of the opening into Grand bay, rises, according to aneroid readings, 470 feet above lake Nipigon and shows only diabase of a very coarse texture. There are three round-topped hills on the promontory suggesting remnants of a sheet, though they may be only small stocks. If a sheet, its chilled upper surface must have been much above the present tops of the hills.

The shore of south bay, so far as seen, is entirely of diabase, sometimes rather low, at other times rising as fine cliffs. Big Flat Rock portage, described in a former Report,[6] is mainly over the flat top of a diabase sheet. A little south of the steamboat landing at Flat Rock, on the shore of a small bay, a dike of coarse flesh colored pegmatite eight inches wide cuts the diabase and may be followed for 20 or 30 feet, partly under water. Close by and parallel to it is another dike of fine-grained granitic rock, similar to one described in the Report mentioned above.

It is rather singular that no well defined old lake terraces have been found near Black Sturgeon lake or the shores of lake Nipigon just described, while fine terraces and delta flats occur along the east shore of lake Nipigon and Nipigon river. It may be that suitable drift materials were lacking toward the southwest end of the lake where no large rivers entered the Nipigon bay of lake Algonquin.

The region traversed by the little used canoe route up Black Sturgeon river, through Nonwatin and Black Sturgeon lakes, and homeward along the south shore of lake Nipigon to Nipigon river, includes some of the finest scenery in northern Ontario, and should be opened up for tourists, since it is included within the easily reached parts of the Nipigon Forest Reserve, one of our Provincial parks. Fish are plentiful and, though no trout were seen, fine black bass were caught where the river enters Black Sturgeon lake. Moose are numerous, and red deer were seen several times also. The timber in the region includes some good bunches of red pine on the east shore of Black Sturgeon lake, and there are many isolated trees of white pine, often of large size, scattered through the region over which we worked. There are also quantities of good spruce, so that the best timber in the forest reserve is found in this southwest corner.

[6] Bur. Mines, 1907, Part I., p. 134.

# BOG IRON ON ENGLISH RIVER

By E S MOORE

## Introduction

In the autumn of 1907 bog iron was discovered on Little Bear lakes southeast of Selwyn lake, and during the following winter on Yellow and Greer lakes along the boundary between the Districts of Thunder Bay and Rainy River. Shortly after this discovery in the Selwyn Lake region, similar deposits were located near Niblock station, on the main line of the Canadian Pacific Railway, and since that time over one hundred and forty claims have been staked out there. Very little development work has been done on the deposits already known, but considerable prospecting has lately been carried on in their vicinity, without the discovery of any new deposits.

Last September the writer received instructions from the Deputy Minister of Mines to examine the bog ores in the districts mentioned and to report on their distribution and economic importance. Consequently, a short time was spent in an examination of those claims which were accessible at that time of the year, and a general knowledge of the deposits and their geological relations was obtained. While engaged in this work Mr. O. Bowles performed the duties of field assistant in a very creditable manner.

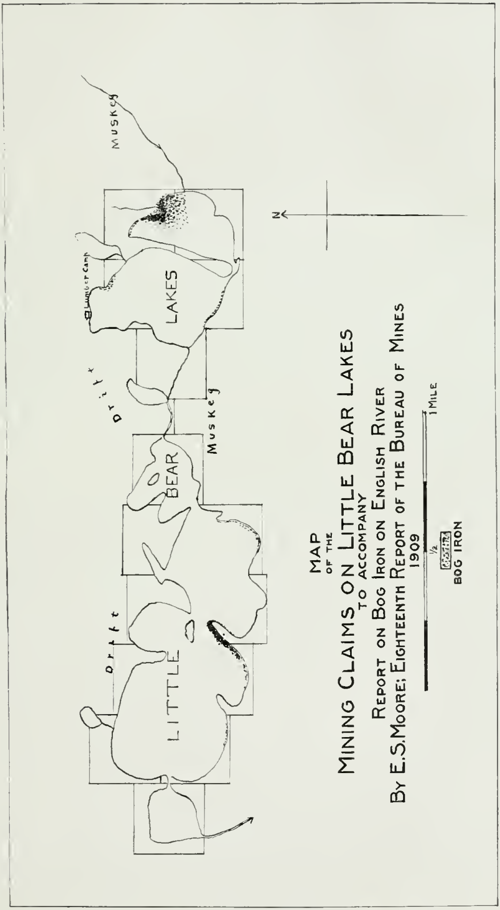
In connection with this Report acknowledgements are due to Mr. J. W. Morgan, Mining Recorder at Port Arthur, who put forth every effort to obtain information for us concerning the region, and to Mr. A. Lougheed, also of Port Arthur, who supplied us with an instrument which proved serviceable in raising samples of mud from the bottoms of the streams and shallow lakes.

## Distribution of the Bog Ore

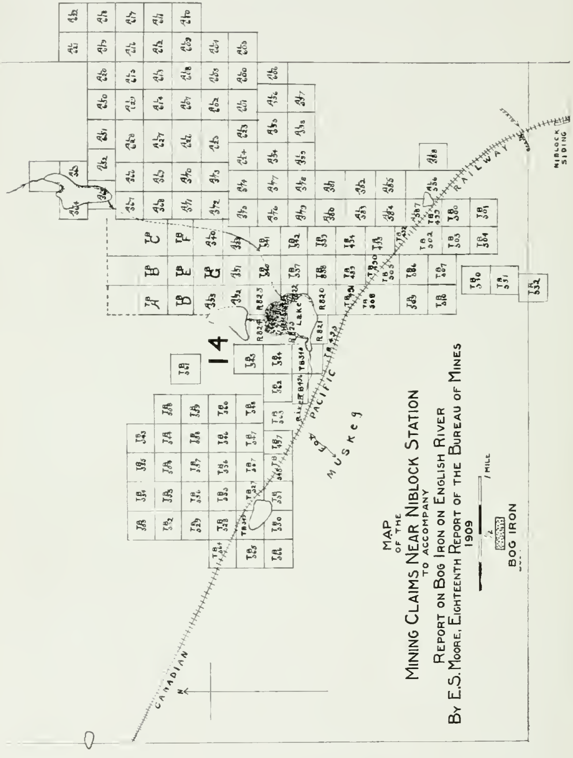
The deposits of bog iron so far recorded in the region under discussion, may be grouped as deposits occurring, (1) on Little Bear lakes, (2) on Greer and Yellow lakes, and (3) in the vicinity of Niblock station. They occur not far from English river, a stream which follows roughly the boundary line between the districts of Rainy River and Thunder Bay, in the region between the main line of the Canadian Pacific railway and the Lake Superior branch of the Grand Trunk Pacific railway.

The first ore to be discovered was found on Little Bear lakes, which lie about seven miles southeast of Selwyn lake, an expansion of English river, just below the G. T. P. railway. They are also placed about four miles northeast of the one hundred and nineteenth mile post, measured from Fort William on this railway. These lakes are reached most easily from the railway track by following a log road, which begins near mile-post one hundred and nineteen, and runs in a general east-northeast direction through a wooded region to the lakes. On the most easterly number of this group a considerable deposit of bog iron occurs and much smaller quantities are found in the northeast corner of the adjoining lake and along the southern shore of the largest lake of the group. It is chiefly along the northwestern border of the projection near the middle of this lake, that the ore occurs. These were the only deposits found in the immediate vicinity of this group of lakes, but on Sand lake, an expansion of Bear river, lying between Little Bear lakes and English river, thin films of bog iron occurred on the beach sand, and there were evidences of it in various places in the swamps in the surrounding districts. Nothing, however, of any economic interest was seen.

Between four and seven miles in a westerly direction from the first rapids on English river above Selwyn lake, there are a number of claims on Yellow and Greer lakes, two small bodies of water lying in an area of large swamps and muskegs. These claims were not visited, because a guide was not available and no trails existed, the


MAP
OF THE
MINING CLAIMS ON LITTLE BEAR LAKES
TO ACCOMPANY
REPORT ON BOG IRON ON ENGLISH RIVER
BY E.S.MOORE; EIGHTEENTH REPORT OF THE BUREAU OF MINES
1909
LITTLE
BEAR
LAKES
Drift
Drift
Muskeg
Muskeg
Lumber Camp
N
1/2
1 MILE
BOG IRON

prospecting having been done in winter. However, the prospector who had staked these claims as well as those in the Little Bear lakes region, and who had very accurately described the deposits on the latter lakes, said those on Yellow and Greer lakes




were of similar character, but less accessible when the lakes were not frozen sufficiently to permit one to work upon the ice.

Passing up English river to the main line of the C. P. R. and going eastward about fifteen miles to Niblock station, one crosses the Height of Land, the continental divide, near Shebandowan siding about half way between English river and Niblock.

Between the latter place and Shebandowan, there is an area covered by large muskegs which are separated only by irregular ridges of drift or granite. These muskegs have scarcely any trees, except on the knolls and ridges, and resemble diminutive prairies covered with Labrador tea and moss, and generally threaded by meandering streams. In this muskeg area the mining claims cover the greater portion of a patch about four miles square with Niblock lying near the southeast corner. Extending north from the railway at a point a little west of Niblock, there is almost continuous muskeg for three miles. Near the northern border of these large muskegs in claims A.L. 561-564, there is a little lake containing a small amount of bog iron along its northern and south-eastern shore, while within a quarter of a mile of the railway and near the centre of the muskeg, Hematite lake contains a considerable deposit along the northern half of its shores.

A number of tests were made in other lakes and in the muskeg at various places, and although in many spots the bottom was not reached owing to the depth of the water in the lakes, or of the peat in the muskegs, where it was reached no iron worthy of mention was found. A small patch, however, covering an area about fifty feet square and about one and one-half feet in maximum depth, had already been uncovered in the muskeg near the point where the C. P. R. crosses the Beaver river.

In summing up the occurrences of bog iron ore in the vicinity of English river, we find deposits on Little Bear lakes, lying east of the river and about four miles north-eastward from the G. T. P. railway. We find some on Greer and Yellow lakes, lying west of the same stream, being about twelve miles west of the above mentioned lakes and five miles from the railway, while there is a gap of about twenty miles between Little Bear lakes and the Niblock deposits, the latter lying in a southerly direction from the former and beyond the Height of Land. McInnes' Ignace sheet, issued by the Canadian Geological Survey covers part of this region, but I regret that no reliable general map, covering all of the region is to be had. The small maps accompanying this Report will show the extent and local distribution of the deposits.

## Rocks of the District

The geological series of this district is a very simple one. The only consolidated rocks appearing in any quantity are hornblende and biotite granite and gneiss of the Laurentian system. Enclosed in these rocks are a few narrow bands of Keewatin schist, which in most cases cannot be readily differentiated from the gneiss, since the granite was originally intrusive into the schist, and the two were so closely folded together that the contacts are indistinct. One narrow band of garnetiferous schist, a rock developed by contact action of the granite on some Keewatin rock, is found at a little rapids on English river, about fourteen miles below the C. P. railway and just below a deserted sawmill on the river bank.

The only other rocks in the region are the drift and some recent clastic and chemical sediments, including the alluvial deposits of the present stream and such chemical sediments as the bog iron. The drift is composed very largely of sand, which in many places contains numerous granite boulders, and its constitution is such that it may have been derived by the disintegration of granite. The disintegrating work was probably accomplished to a large extent by the glacier in its passage over the great granite region to the north. This sand is found everywhere, in the bottoms of streams and lakes, around shores and on hills. Its almost white color gives no evidence of the presence of any considerable proportion of iron, but if it be heated it takes on a red color by the oxidizing of the iron, which is there in an inconspicuous form, and which, under the microscope, may be seen to constitute a very thin red coating on parts of some of the quartz and feldspar grains. The drift throughout the district exists in the form of ground moraines, and terminal moraines accompanied in places by kames and eskers, and in the vicinity of Niblock the latter moraines cap the continental divide.

### Physiographic History of the District

After the intrusion of the Laurentian granite into the Keewatin rocks there followed a long period of base-levelling. This base-levelling affected practically all of the Archean continent, and in the region under consideration there is no definite evidence that any rocks of post-Laurentian and pre-Pleistocene age were laid down on this eroded surface. It is quite probable, however, on account of their occurrence in surrounding regions that such rocks were formed, and later were entirely removed by erosion. When the glacier passed over the region great quantities of drift were deposited on the surface, filling up stream channels and compelling the streams to seek new courses. As the relief in the underlying rocks was low, the change in the courses of the streams only resulted in their passing over comparatively low ledges of gneiss, making small waterfalls, or in their developing rapids where numerous boulders from the drift blocked their channels. Above these falls and rapids the streams soon reduced their beds to local base-levels in the easily eroded sand, and now they are nearly all sluggish, meandering streams in the stretches between the points where their courses are obstructed. There is so much material for the streams to carry that they become heavily loaded with sediment near their heads, when their velocity increases in flood-time. As a consequence of this overloading of the streams their velocity is always kept low, and where they reach their flood-plains they deposit large quantities of sediment, which fills up the channel, causing the streams to extend themselves laterally. Thus most of these streams have comparatively wide flood-plains.

The streams connect numerous small, shallow lakes lying in the depressions in the drift. Most of these lakes, which exist during the summer season, are mere remnants of much larger lakes which are now nearly destroyed by being filled with peat. In the wet season these peat bogs again become lakes, and large areas, which are comparatively dry in the summer, become completely submerged. The depressions developed in the Laurentian rocks by differential weathering, form more or less impervious basins for water, and when a region underlain by granite becomes heavily coated with drift so that streams are sluggish and small lakes are formed, ideal conditions are developed for the deposition of bog ore. It is not that the sands or other rocks of a region such as this, are such as would supply more iron than those of some other, or even as much, but the physiographic conditions are such, that the organic acids of the plants are able to extract from the drift and the other rocks a comparatively large amount of iron salts, and to supply these to the sluggish streams whose waters soak through the sand. When these slow-moving streams enter the shallow lakes already mentioned there is a good opportunity for the iron salts to become oxidized and to be precipitated in the form of bog iron. These conditions seem to be characteristic of bog iron regions, being found in Quebec, Sweden and other places where large deposits of bog ore are found, but in these regions the lakes containing most of the ore are larger than those in the districts around English river. The size of the lake may have some influence on the extent of the ore deposit. One other difference might also be mentioned, and that is the greater proportional amount of clay and smaller amount of sand found in Quebec. This may have some bearing on the value of the deposit, because where much sand is present it is continually shifted by the waves and becomes mixed with the ore.

The Height of Land passes just northwest of Niblock, and here, as along a great part of this divide, the streams are very sluggish. This is because drainage conditions are in a more youthful stage than in the lower part of the streams which rise near the divide. It is also characteristic for the streams to take their origin in large swamps and muskegs located on drift, which is so plentiful along the divide and which so often caps it.

From what has been said it will be seen that for several reasons the artificial drainage of the lakes of the bog iron district would be difficult. The chief difficulties would

lie in the ever rapidly renewed supply of sediment, which overloads the streams and makes them sluggish, in the large size of the basins which become lakes in high water, and in the comparatively low relief of the ancient peneplains on which these bodies of water lie.

## Description of the Deposits

Under this head there will be considered (1), the manner of occurrence of the ore, and (2), the extent or size of the deposits.

Bog iron ore below a layer of soil, near Niblock station. Hammer lies on ore.

### How the Iron Occurs

The iron occurs in both the ferrous and ferric conditions, and as a combination of the two forms. The ferrous form exists in the state of the greenish salt, or salts of the protoxide, and the ferric form as the common hydrous oxide, limonite. The ferrous salts are in all probability the sulphate and silicate, chiefly the latter. The combination of the two oxides gives a small amount of magnetite, which cannot be proved to originate in the bog, as it may have been carried in by streams and deposited as a clastic sediment. It is found in very small fragments, which can easily be separated from the other oxides by use of a magnet. No carbonate of iron was detected.

According to Julien[1] this salt is not formed in a bog or near the surface at the present day. It is, however, frequently observed in bogs at a short distance below the surface, where the decay of vegetable matter gives rise to carbon dioxide, but where there is not a sufficient supply of oxygen to form the soluble humates by combining with organic substances.

The limonite occurs in red, brown and yellow colors, and forms either soft or hard, bedded masses, concretions, slimy mud, or cement in sand. In the mud there is usually more of the ferrous salt, than of the ferric, because of the abundance of organic material which acts as a reducing agent, preventing the oxidation of material carried into the bog in the ferrous condition, and even reducing the ferric oxide. This reducing action may be readily observed along the shores of the lakes where vegetable matter is present. Here the red or brown limonite concretions, which have a thickness of eight or ten inches, become gradually dissolved away in the lower layers of the deposit and changed to a greenish salt. The gradual dissolution of the concretions may be observed with increasing depth. This condition is similar to that which is found in the bogs of Quebec.[2] This greenish salt readily turns red on heating, on account of its oxidation to the anhydrous oxide, hematite. As some manganese occurs in these deposits, a portion of the black and greenish colors is due to its presence in different forms.

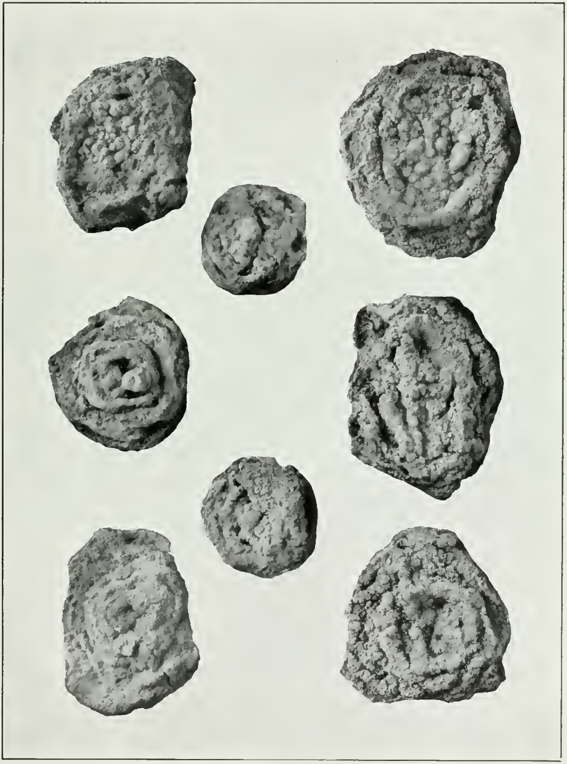
The soft, bedded, yellow limonite occurs in the most easterly of the Little Bear lakes as a layer four inches in depth, in water about two feet deep. It is badly mixed with sand and is consequently of low grade. A partial analysis of a sample of this by Mr. N. L. Turner, Provincial Assayer, gave: Silica 35.17 per cent., metallic iron 27.34 per cent., carbon dioxide absent; loss on ignition 8.52 per cent. A similar deposit covering an area about fifty feet square to a maximum depth of one and one-half feet occurs near the C. P. railway in peat and under a layer of alluvium about three inches thick. Parts of this mass are hard, brown limonite, which resists digging with a spade, but most of it is a comparatively soft, yellow mass with the roots of plants running through it.

#### Concretionary Discs of Ore

The most frequent occurrence of the iron is in the form of concretions, which assume various shapes. They are dark brown or yellowish brown in color, rather disc-shaped and possess a roughly spiral structure. To one used to camp life the disc shaped forms immediately suggest dried apricots, while some other forms more irregular in shape and more nearly equi-dimensional strongly resemble dried prunes. The larger ones are more of a concave cake-shape. They vary in size from half an inch to three inches in diameter, while most of them are from one inch to two inches in diameter and from one-quarter to one-half an inch in thickness. These are much smaller than the large ones found in Quebec or in New Brunswick, where Chalmers states that the larger cakes have a diameter as great as from two to three feet.[3] In most cases when one of these bodies is broken, it exhibits a skeleton structure of hard, brittle, metallic limonite. These concretions occur along sandy shores of the lakes and in the shallow waters. They were found extending a distance of two hundred yards from shore, but few of them in water more than two feet deep. They apparently owe their origin, partly at least, to the presence of sand which forms nuclei for centres of crystallization. There is no doubt that some close connection exists between the formation of these concretions, the movement of sand by the waves, and the depth at which the limonite can harden. When the water in the lakes becomes low in the summer time, considerable areas of concretions become exposed to the air, and along the edge of the water they become piled up by the waves. It can be observed that the deposit of these bodies is thickest near the water's edge, and that it thins both toward the lake and the land.

[1] A. A. Julien, The Geological Action of the Humus Acids, Proc. Amer. Assn. for the Adv. of Sc. Vol. 28, p. 403.
[2] Geology of Canada, 1863, p. 511.
[3] Can. Geo. Sur., 1882-84, p. 46 GG.

A thin section was made from one of these concretions, and another one was ground to a smooth surface so that its internal structure could be seen. An examination of these specimens showed an opaque reddish-brown mass, which was not entirely homo-



Bog iron ore concretions from Hematite lake, near Niblock station. Natural size.

geneous, although no distinguishing feature, beyond a finely porous condition, could be detected. In this mass were numerous fragments of quartz and a few of feldspar,

the latter nearly all orthoclase. The fragments were angular, subangular, or rounded, and there was no definite orientation of their longer axes, although a roughly concentric arrangement could be observed in one case. The fragments were arranged either in bunches or as individuals scattered through the limonite groundmass. An analysis of some of these concretions made by Mr. N. L. Turner gave: silica (soluble) 8.92 per cent., silica (insoluble) 4.88 per cent., ferric iron ($Fe_2O_3$) 68.36 per cent., ferrous iron (Fe O) 2.16 per cent., metallic iron 49.5 per cent. The metallic iron is a little lower than that of the average bog ore worked in other regions.

The slimy mud already mentioned may contain very little limonite and may be composed almost entirely of the ferrous salts, fine clay and organic matter. It is known to have a depth of eight feet in one of the lakes, but its content of iron is very low, and one and one-half feet of it would not contain more iron than that required to form an inch of solid limonite. It is found in the deeper parts of the lakes and in some sluggish streams.

#### Extent of the Deposits

Bog iron is rather widely distributed in the English river district, but concentration has occurred at a few points only. These points are, as indicated by the accompanying maps, on the most easterly of the Little Bear lakes and on the south side of the largest lake of this group; on Hematite lake; on a small lake covering a portion of claims A.L. 561-564; near Niblock, and on the bank of Beaver river at the railway crossing. None of these deposits shows any large quantity of iron, although it is possible that development work might reveal the presence of beds of ore under the sand in some of the lakes, and as isolated bodies in peat beds. It occurs under these conditions in the bog regions of Quebec, though there are there much larger deposits in sight than any in the regions under discussion.[4]

#### Little Bear Lakes

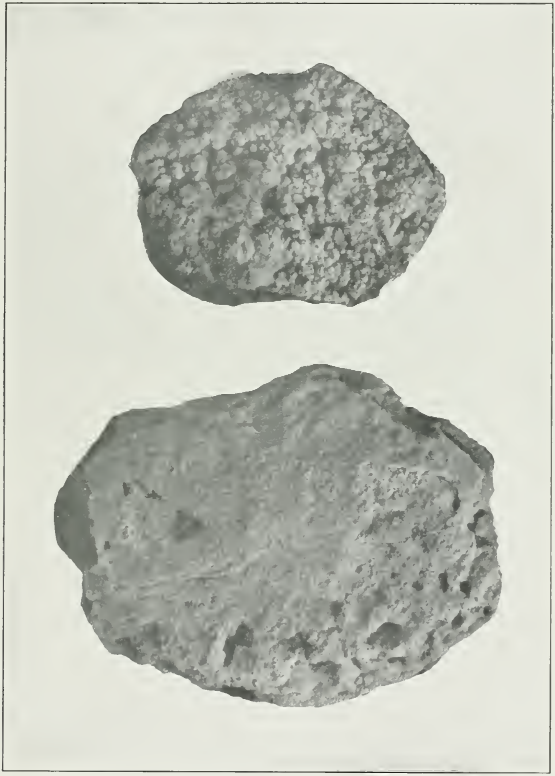
On the first lake mentioned there was exposed on a point at its northern end, an area of sand forty-five yards wide and one hundred yards long. This area was covered to a varying depth of one to ten inches by mixed limonite and sand, with a thin layer of concretions on top. In the lower portions of this bed the iron was in the form of red and green mud mixed with sand, and there is a gradual transition toward the top through soft mud and fragments of broken concretions, to fresh and intact concretions. The deposit was thickest along the water line. In passing outward into the lake one could find concretions scattered in a thin layer over the bottom for some twenty yards, at which point the water deepened and soft mud occurred.

By means of a raft a portion of the lake was tested, and it was found that the lake bottom was very irregular in profile, and that the iron deposit was not uniform over the bottom. In some places the water was so deep that the bottom could not be reached with the tools at our disposal, but in places as much as six feet of slimy mud was found, and in other places where the water was shallower, yellow ochre occurred over limited areas. Many patches of the bottom showed nothing but sand, and it was concluded from all the observations that the deposits of iron were quite limited.

It was further observed that the iron was practically confined to the northern end of the lake, and this seemed to be a constant feature of all the larger occurrences in the region. The cause of this is probably found in the fact that the streams which supply the iron enter the northern part of the lake in every case, and further, that the prevailing winds in summer, when the evaporation of the water and the concentration of the solutions of iron is greatest, tend to drive the water from the creeks toward the northern end of the lake, where precipitation takes place in the shallow

[4] Ells, Can. Geo. Sur., Vol. 11, 1898, pp. 58-60J.

water. The rolling sand grains probably act as nuclei for the concretions, as other bodies are known to do for concretions in many places. There was almost no iron found



Bog iron ore concretions from Little Bear lakes. Natural size.

anywhere along a beach which was not sandy. Further notes on the influence of physical conditions on precipitation of the iron will be found in the section dealing with the genesis of the ore.

Going westward from the deposits described above, there is found a layer of concretions along the northwest side of the little peninsula on the south side of the largest of the Little Bear lakes. These extend for seven hundred feet along the shore and they were traced, by wading, for twenty yards into the lake. The thickness of the layer of concretions varies from almost nothing, to four inches, and a good deal of sand and gravel is contained in it. The lower part of it is greenish from the presence of ferrous salts. A few concretions were found scattered along the shore of this lake in several other places, but the quantity was very small.

Bog iron ore concretions, shore of Hematite lake.

**Hematite Lake**

The most important deposit of the region was found around Hematite lake, and. as on the Little Bear lakes, it was practically confined to the northern half of the lake. Beginning near the outlet and following the shore, one finds an almost continuous band of limonite mixed with sand, extending around the northern half of the lake. It varies in depth from one inch to fifteen inches, and in width from one foot to three hundred feet. The maximum width is obtained near the extreme north end of the lake. In color the deposit is of varying shades of brown, red, yellow or greenish black. Some parts of the band are covered by a thin layer of concretions which

tend to become disintegrated in the lower portion of the deposit. The sand is a rather pure feldspar and quartz sand with a little mica, and of the type common to this district.

An attempt was made to test the lake for ore by means of a punt and a sort of iron pump attached to the end of a long pole. It was found that the lake was shallow and that the water above the mud on the bottom was nowhere more than ten feet deep, but we were not always able to reach the bottom of the mud because of the difficulty in withdrawing the pole. There was lying above the sand at least six feet of a very thin slimy mud of greenish and black color, made up to a large extent of vegetable matter. It would require at least two feet of this mud to make an inch of limonite. It was further found that when the water was not more than one and a half or two feet deep, the sand was mantled with a thin and broken layer of concretions, even to a distance, at one point, of two hundred yards from the shore.

The deposit near the point where the C. P. R. crosses the Beaver river, is about fifty feet square; and from a maximum thickness of one and a half feet it thins rapidly to zero.

The iron around the small lake in claims, A.L. 561-564, is very limited, being confined to a few concretions scattered around the northern and southeastern shores.

### Origin of the Bog Iron

A great deal has been written on the subject of the origin of bog iron ores, and only a few principles and facts which seem to bear upon the conditions existing in the English River district will be cited here.

In going into this district with a view to studying the bog deposits, a few conditions attract the attention of the observer. The chief of these are the unusually large muskegs, with their meandering streams and great quantities of vegetable matter, the presence everywhere of the sand, which contains apparently so little iron, and the red streams which deposit iron in the lakes and on almost every object they touch.

We may first consider the source of this iron. As previously mentioned, the sand which is the principal substance over which the waters flow, is made up chiefly of quartz and feldspar, the former barren of iron, and the latter also barren except for the very small proportion which may exist as coloring matter. Besides these two minerals there are minor amounts of biotite, hornblende, magnetite, pyrite, ilmenite, pyroxene, and other iron-bearing minerals. Although the greater portion of the sand has been derived from the granite, a considerable amount must have come from diabase and gabbro, so widely distributed to the north, and from the Iron formations, which have suffered so much erosion. Besides these sources, there is the probable source from previous bog deposits, which were eroded by the glacier and the contents mixed with the sand. An examination of the sand showed that iron existed everywhere as a thin coating on the grains, which became red on heating and when examined under the microscope showed a very thin coating of iron oxide. However inadequate the sand may appear as the source of the iron, it is the only rock present that can furnish it.

### How Water Carries the Iron

As to the quantity of iron in solution at any time, a few analyses of water collected from streams and lakes in the region and analysed by Mr. S. J. Lloyd, M.Sc., will be of interest. The quantities of water collected were necessarily small, and it was not possible to obtain from them sufficiently accurate quantitative results for substances such as carbon dioxide, silica and manganese, although the two latter were present in very small amounts. There was, however, so much iron in the water that in every case flocculent iron hydrate precipitated from apparently clear water, after standing a few days in corked bottles. In one case there was enough of the precipitate to almost cover the bottom of the bottle.

To find if possible the relation existing between the proportion of iron carried by the streams, and that contained in the lake waters, samples were collected from the most easterly of the Little Bear lakes, near the point where the most iron was precipitated, and from the main creek entering this lake. This creek rises in the large muskeg to the northeast, and where the stones are left bare along its bed by the lowering of the stream in the dry season, they are coated red with a layer of oxide.

Analysis No. 1 of the water from this stream showed .061 grammes $Fe_2O_3$ per litre, No. 2 from the lake contains .056 grammes $Fe_2O_3$ per litre and a trace of manganese. These figures indicate that the creek was carrying ferric oxide at the rate of about one-eighth of a pound to a ton of water. When one considers that this stream was about three feet wide and four inches deep and flowed at a moderate velocity, an estimate may be made of the amount of iron which would be carried by it in the course

Bog iron and sand on shore of Hematite lake, near Niblock station.

of a season or a decade. As an example of the rate at which bog ore collects, P. H. Griffin states that in Lac-a-la Tortue, Quebec, paying quantities of ore could be obtained from areas completely exhausted some eight or ten years previously,[5] and other writers have stated that ore is renewed in the lakes of Sweden in twenty-five years.

Three samples were collected from the water around Hematite lake, and the following analyses obtained. The first was taken from the creek at the outlet of the small lake in claims A.L. 561-564, and yielded according to analysis No. 3, .047 grammes $Fe_2O_3$ per litre. To ascertain the effect produced on this stream by flowing through more than two miles of peat to Hematite lake, a sample was collected from the stream near this lake and the analysis, No. 4 with .045 grammes $Fe_2O_3$ per litre, instead of showing an increase of iron as was anticipated, showed a slight decrease. This decrease might be due to the thorough leaching which the sands and peat along the stream had already suffered, depriving them of any soluble salts of iron which the stream

[5] P. H. Griffin, M.E., Trans. Amer. Inst. Min. Eng., Vol. 21. 1892-3, p. 974.

might obtain. This leaching out of all available salts of iron might result in precipitation instead of an addition of iron, on account of the oxidation of the salts already in solution.

Analysis No. 4 showing .021 grammes $Fe_2O_3$ per litre was stated by the analyst to be a little uncertain. However, it represents approximately the proportion of iron carried by the streams draining Hematite lake, as the sample was collected from the stream near the outlet. Comparing the latter analysis with that of the water entering the lake, it will be seen that a considerable portion of the iron is left behind, but about half of that which enters the lake passes on with the stream.

### Solvents for the Iron

It is generally agreed that plants are the chief agents in producing chemical action in the formation of bog iron. Small amounts of iron may be carried as ferrous sulphate derived by the oxidation of pyrite, but this quantity is comparatively small when compared with that which is derived by the action of the organic acids upon iron-bearing silicates. The action of these acids is well described by Julien in the article already cited and he gives so many examples of the action of these acids, that their importance seems to be fully demonstrated. They are also capable of dissolving sufficient silica to supply the quantity of soluble silica found in bog ores. This quantity will vary from almost nothing to over 20 per cent., and in an analysis of concretions already given in this paper, the soluble silica amounted to 8.92 per cent.

The organic acids include among others less common, crenic, apocrenic and humic acids, and of these the crenic compounds are probably the most active agents in the solution of minerals. Probably the best illustration of the action of these acids in the formation of bog ores, is furnished by the chemical experiments of T. Sterry Hunt[7] in which he showed that a sample of bog iron ore contained 15.01 per cent. of organic acids, crenic and apocrenic.

The action of carbon dioxide is an important factor in the weathering of minerals, but unless it is accompanied by other organic constituents its action is comparatively small. Professor Ossian Ascham[8] claims that organic acids rich in carbon dioxide act upon rocks in a chemical manner, and as soon as they have freed some bases, such as potassium, magnesium and iron, certain bacteria are able to begin work and aid in the solution of the minerals, by feeding upon the humates developed from these bases. As a result of the action of these bacteria the iron humates are decomposed and finally give up the iron in the form of limonite.

### Precipitation of Iron in the Bog

The small amount of ferrous sulphate, which is carried into the bog in solution, can be readily precipitated by calcium carbonate, which is commonly present in solution, and the result will be calcium sulphate and ferrous carbonate ($FeSO_4 + CaCO_3 = CaSO_4 + FeCO_3$). But as the oxygen of the air is always present at the surface of the bog lakes, the ferrous carbonate is not formed, and instead of it the ferric hydrate, limonite, results thus; $2FeSO_4 + 2CaCO_3 + 3H_2O + O = 2CaSO_4 + Fe_2O_3 + 3H_2O + 2CO_2$. The limonite thus formed collects as a thin film on the surface of the water, to sink later or become deposited on objects along the shore. Such a thin film may frequently be seen where a little stream seeps out of a bank containing pyrite, and it may also be seen where organic material is plentiful. This oxidizing influence is not entirely confined to the surface, and this is especially the case when the water is disturbed by wind.

The action which takes place when the iron humates, *i.e.* the iron salts of the organic acids, reach the bog lakes where they become exposed to oxidizing influences, is rather indefinite and complicated. It is generally agreed, however, that these salts

[6] A. A. Julien, Proc. Amer. Assn. for the Adv. of Sc., Vol. 28, 1875, pp. 311-410.
[7] Geol. of Canada, 1863, pp. 512-513
[8] Zeit. für Proct. Geol., 1907, pp. 56-62.

become oxidized and the insoluble limonite results. It is supposed, as already pointed out, that bacteria play some part in the freeing of the iron hydrate from solution by the breaking up of the humates.

There are certain physical forces which also appear to influence the precipitation of the hydrates. The association of the iron with sandy beaches and the development of the deposits on certain portions of the lake are striking features. The sand grains probably serve as nuclei about which crystallization takes place. After some iron has been deposited the force of crystallization causes a further precipitation. This influence of the presence of iron is illustrated in bog iron regions where all iron pipes used for the transportation of water become heavily coated with iron hydrate. A piece of iron, suspended in one of the lakes in Quebec, soon became coated with this mineral. The winds which tend to blow from about the same general direction during the summer, when the iron solutions are the most concentrated and likely to produce a maximum precipitation, drive the water toward the northern and eastern sides of the lake. When the solutions are continually passed back and forth over the concretions already formed, precipitation will be aided. It is also known that the movement of water will sometimes tend to cause a deposit of a salt from solution, as for example it has been stated that at the foot of waterfalls calcium carbonate was formed, when there seems to be no other reason for its formation than the escape of carbon dioxide due to the movement of the water. Of course, the wave action in a bog lake would cause more perfect oxidation of the water. These various forces tending to deposit the iron, act in a cumulative manner by increasing precipitation because of the presence of iron already precipitated, and by building out those spits or points where greatest accumulation occurs, so that the currents along shore tend to converge at certain points and make further deposits. Examples were seen in the field, where the direction of the current had an influence on the deposits, as such were likely to be found where a current drifted along a sandy point.

There is one other condition which may be mentioned, as probably having a small influence on precipitation. When examining the deposits on the Little Bear lakes, it was found that a person wading out into the water would suddenly experience a very sudden change in the temperature of the water at a short distance from shore, although the wind was blowing at the time and to all appearances the water was pretty well disturbed. The point at which this change occurred was just about the point where the concretions ceased to form on the bottom and the water became only a little deeper. The cause of this difference in temperature was attributed to the great effect of the reflection, where the water was shallow, of the sun's rays by the sand of the lake bottom. The question which immediately arose was whether the increased temperature might have any influence in precipitating the iron by greater evaporation and concentration in this area, and whether the greater amount of light dispersed through the water would have any influence in dehydrating and hardening the limonite.

There has been in the past considerable speculation concerning the cause and the process of the hardening and the dehydrating of limonite. The observations of W. Spring are interesting in this connection. He states that iron hydroxide spontaneously loses its water if the iron is not combined chemically with some other substance. The yellow ochre color would thus indicate the presence of $Al_2O_3$, CaO, MgO, etc. Wittstein found that if iron hydrate was left for several years under water at ordinary temperatures, it dehydrated and became crystalline. It is stated that organisms may dehydrate limonite. Spring concludes that iron hydrate is thus not a stable compound, and gives up its water when it is not in chemical equilibrium with other oxides.

### Bog Iron Elsewhere in Canada

Bog iron has not been mined to any great extent in Ontario. It is reported from Carleton, Norfolk, Kent, and Leeds counties. A deposit at Rondeau, Kent county, was worked some years ago, but has since been abandoned. A furnace was built at

Normandale, Norfolk county, but it has long since been abandoned. Bog ore is also found in Muskoka.

In Quebec and the Eastern Provinces bog iron is plentiful and widely distributed. An area containing many deposits of ore extends along the north side of the St. Lawrence river from northwest of Montreal to the vicinity of Quebec. Ore was mined and smelted in St. Maurice, Quebec, as early as 1737, and since that time work has been carried on almost continuously, though a few periods intervened during which little mining was done. The bogs in this vicinity supplied ore to the furnaces for one hundred and fifty years, but they are now mostly worked out.

The region where these deposits occur is covered with drift, consisting of sand and clay, and judging from the Geological Survey Reports, there is a greater proportion of clay in the drift than there is in the English River district. The solid rocks outcropping on the north side of this belt are Laurentian granites and gneisses, and they appear to have furnished much of the sand found in the region. The ore occurs in the form of soft ore and as concretions, which in some cases reach a considerable size. As already mentioned, Chalmers reports cake-like aggregations in New Brunswick, which measured even three feet in diameter, but most of the cakes are much smaller. The deposits are often quite large. Beds are reported which cover three acres to a depth of four to eight feet, and one at St. Anne de Beaupré, covers four acres to a depth of four to seventeen feet. Numerous patches, often of small size, are found in the peat bogs and buried by alluvium.

The most noted region for bog ore in Canada is Radnor Forges district not far from Three Rivers, Quebec. In this district Lac Tortue and Lac aux Sables supply a large quantity of ore. The muddy ore is raised from the bottom of the lake by an endless chain dredge, then passed over seives and washed. The lake is shallow and the whole bottom can be worked over. The ore accumulates very rapidly, and P. H Griffin[9] states that portions of the lake completely exhausted produced paying quantities of ore ten years later. As a rule the ore occurs from twelve to eighteen inches below the surface of the water, and where found deeper than this, is usually of old formation. In one case six feet of ore was found buried under the sand in the bottom of the lake. Much of the ore consists of concretions, and some of it is in hard layers, so hard that it cannot be dredged.

The cost of the ore at the furnace is said to be about $2.50, or more, per ton. It averages about 50 per cent. iron and contains very little phosphorus or sulphur. It is this low percentage of phosphorus and sulphur which has made the iron obtained from bog ores so valuable. The Swedish pig made from bog ore is the basis for nearly all the famous steels made in England. In Quebec, the iron has been used mostly in making an excellent quality of car wheels. It has also been used in the manufacture of excellent axes and scythes. Limonite has an extensive use, when it can be conveniently obtained, in the manufacture of gas, where it is employed in the extraction of the sulphur.

## Economic Possibilities of English River Region

After a careful consideration of the bog iron deposits in this vicinity, the writer has concluded that there is not sufficient iron in sight to warrant much expenditure in attempting to work them, although some tons might be collected from the larger deposits by washing the sandy ore. The presence of these deposits, however, shows that prospecting in the region is warranted, and that there is a possibility of finding other deposits in lakes not yet explored, and in some of the large peat bogs. Should old deposits exist they will probably be found within a short distance of the surface of the sand.

[9] Trans. Amer. Inst. Min. Eng., Vol. 21, 1892-93, p. 974.

# GEOLOGY OF ONAMAN IRON RANGE AREA

By E S MOORE

## I. Introduction

The Onaman Iron Range area comprises about 70 square miles, lying northeast of Lake Nipigon and surrounding the head waters of the Red Paint river. It was from this stream that the area obtained its name, but the more euphonious Ojibway term, Onaman, has been substituted for the English, Red Paint. A geological survey was begun by the writer in August, 1907, according to instructions received from Mr. T. W. Gibson, Deputy Minister of Mines, but the time available proving too short for the completion of the work, a report covering a portion of the region was published[1] the following winter and the field work completed in 1908. In the above mentioned report there will be found a detailed description of the Red Paint river and some general information relating to the surrounding region, not contained in this article.

After the completion of the field work and the examination of over 200 thin sections of rocks from this region and the similar one lying along the Sturgeon river, 50 miles to the south, it is possible to give a more satisfactory and definite account of the geology of the area than was previously attempted, and in any case where the two reports differ this one is to be regarded as final. Although greater knowledge of the region has been obtained, there still remain problems which cannot yet be settled, principally because of the great metamorphism which the rocks have suffered and the thick mantle of drift, which conceals so many of the contacts.

The region has so lately been opened up that previous to the time of the survey mentioned above, no geological work had been done upon it. As a consequence of this, no mention of it is found in the literature beyond a mere reference by one of the geologists[2] of the Canadian Geological Survey who passed through this portion of the Nipigon district on a reconnaissance trip. The district, however, resembles in many respects some of the iron-bearing districts south of lake Superior, and the literature on these areas has been largely drawn upon for purposes of comparison.

During the preparation of this report much assistance has been received from various persons, and I desire to express my sincere gratitude to all those who have so generously rendered it. Special thanks are due to Messrs. W. F. Green and O. Bowles, who filled in an efficient manner the position of field assistant during the field season, and to the professors of the Geological Department of the University of Chicago, who have criticized and directed my work. To Professor Bensley, also of the University of Chicago, I am much indebted for his kindness in making some of the photomicrographs for this paper. Professor Leith of the University of Wisconsin has been good enough to offer suggestions regarding the geological relations of the district and to place at my disposal the results of some of his work. I regret that his monograph on the pre-Cambrian is not yet published, as it will contain much valuable data on the iron ranges, and throw considerable light on difficult problems connected with their origin.

## II.—History of the District

The iron ranges of this district first attracted attention about the year 1904, when engineers began the survey of the National Transcontinental railway line through the region northeast of Lake Nipigon. As this line runs close to some of the outcrops, and the work connected with the surveying of it brought a number of people through this previously neglected and isolated region, considerable interest was soon manifested in the Iron formation. Shortly after the discovery of iron a number of claims were recorded by the Flaherty syndicate, and within the last two years a new iron range has

[1] 17th Rep. Bur. Min. (1908), pp. 170-199.   [2] Dr. W. A. Parks Can. Geol. Sur. Rep., Vol. XV., p. 221A.

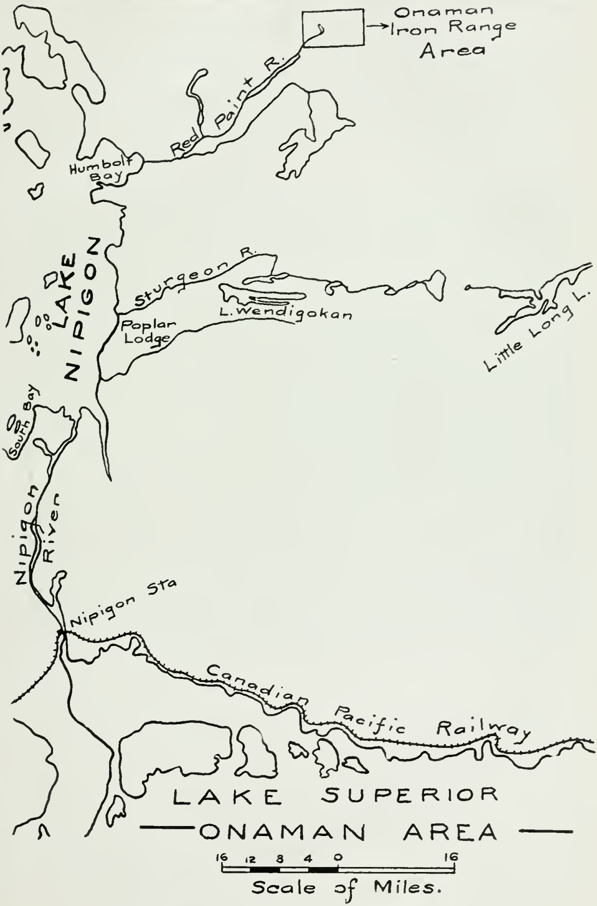



Fig. 2 A. Sketch map showing position of the Onaman Iron Range area.

been located by C. Bain, about two miles south of the first claims staked. A number of prospectors entered the field in the summer of 1906 and prospecting for iron was actively carried on, but without much success.

Since there is at present no railway within 140 miles of the iron ranges of this district, and the Iron formation does not show "pay" ore, no development work has been carried on beyond one short season of diamond drilling, and sufficient trenching and stripping to satisfy the requirements of the Ontario Mining Act. The diamond drill outfit used in the district was transported up the Red Paint river and down Johnson creek, a total distance of nearly 55 miles. The means of transport were canoes and packstraps, and there is probably not another case in the history of mining in Ontario

Fig. 1. Prospectors' camp on the southern iron range.

where such a feat has been accomplished. The building of the new railway, which will pass close to one of the iron ranges, will doubtless revive some of the interest previously shown in this district.

## III.—Geography

### Position and Extent of the District

The area under discussion lies in unsurveyed territory, within the limits of latitude 50° and 50° 30′ and longitude 87° 10′ and 87° 25′. Its long axis extends east and west across the Height of Land, the continental divide running east and west across Canada, and the western end of this axis lies about 45 miles up the Red Paint river, northeast of Lake Nipigon. (See Fig 2A.) To reach the district one leaves the main line of the Canadian Pacific railway at Nipigon village and travels to South Bay,

a little harbor at the south end of lake Nipigon, and from this point a journey of 50 miles is made to the mouth of the Red Paint river, which empties into Humbolt bay. The journey of 35 miles between the village and the lake may be made either by canoe or by a tug and tramway, which have been put into commission in connection with the construction work on the Transcontinental Railway line, and that across the lake either by canoe or steamer. The canoe trip of 50 miles from the mouth to the head waters of the Red Paint is easily made. Although there are twelve portages, the longest of them is only two-thirds of a mile, and the others are much shorter. All have well beaten trails. A good portage of one mile and a quarter crosses the divide and connects the Red Paint river with Johnson creek. The latter stream flows in the

Fig. 2. Geological party crossing Lake Nipigon by canoe.

opposite direction to the former, and for a considerable distance follows closely the iron range along the east side of the divide.

As indicated on the accompanying map, the Onaman Iron Range district includes an area about 11 miles long and 7 wide. Although this is the extent of the area mapped, there are two small areas outside of this which will be considered when discussing the geology of the district, because they are not far removed geographically from the main iron ranges and are closely related to them geologically. These areas are found at the "Red" or ninth portage on the Red Paint river, about 21 miles from its mouth, and on Ste. Marie's lake. The latter area is locally known as Trombley's claims and is situated 8 miles west of Wilgar lake, along the line of the National Transcontinental railway. Both of these areas are interesting because of the contact metamorphism exhibited in the rocks.

### Climate, Soil and Vegetation

The climate in this portion of Ontario is similar to that along the continental divide in many other parts of the Province. It is characterized by cool, and, as a rule, wet summers, and very cold, dry winters. There may be frosts during every month of the year, due principally to the presence of large swamps and muskegs which retain snow and ice throughout the year and thus reduce the summer temperature in their vicinity. Cultivation and drainage of the district would largely reduce the summer frosts, but the region does not give promise of becoming an agricultural one. The soil is mostly too light for agricultural purposes, although some of the clay flats around the Height of Land and the clay plains along the lower stretches of the rivers rising in the vicinity contain soil suitable for hardy crops. Wild strawberries grow in abundance on some of these flats, and the cache-keepers at Cache 12A had a garden containing fairly good beans, lettuce, turnips, radishes and other vegetables and roots.

An abundance of rain fell during the parts of two seasons spent in the field. In 1907, which was exceptionally wet, rain fell on 22 days in July and 17 in August, and in 1908 there were 19 days with rain during the latter month. This record corresponds well with athat of many other months. The great precipitation may be due to the chilling of the warmer southerly air currents laden with moisture, by the cool air of the Hudson Bay slope.

Possibly on account of the cold climate and the nature of the soil, many trees common as far north as the northeast shore of Lake Superior and some common even in the southern portion of the Nipigon region, are not found here. No red or white pine occurs, but the more hardy evergreens flourish. The district has suffered terribly from forest fires, which in 1906 burned large areas almost bare of vegetation. Fires had also occurred during several seasons previous to this, and almost all the higher lands have been burned over, so that now they are covered with a tangled mass of dead timber, through which a new generation of trees is growing up. Great difficulty is experienced in travelling through parts of the district because of the piling up of the dead trees in the burned area, but the fact that the moss has been burned from the rocks greatly aids the geologist or prospector in search of rock outcrops.

The swamps and stream borders have escaped the fires, and so have some of the higher spots surrounded by these wet lands. In these swamps and along the streams occur the black spruce (*Picea nigra*), the white spruce (*Picea alba*), the cedar (*Thuja occidentalis*), the balsam (*Abies balsamea*) and the tamarac (*Larix americana*). On the sand plains the jack pine (*Pinus banksiana*) is especially common, and on other dry lands the poplar (*Populus tremuloides*) and white birch (*Betula papyrifera*) are plentiful. Large areas are covered with muskegs on which few trees grow, but which are covered with sphagnum moss. In these muskegs the pitcher plant is a very characteristic feature. The alder grows in thick banks along the streams and causes great annoyance to any one canoeing on small creeks.

Among small fruits, blueberries are very plentiful on the sand plains and rocky knolls and, as already mentioned, wild strawberries are found on the clay flats.

Around the Height of Land the timber is all small, but there is a general increase in size of the trees as one descends the streams from the divide. On the lower stretches of many of these streams good spruce and tamarac occur and numerous trees are suitable for lumber.

### Fish and Game

The lakes and some of the streams abound with fish. The lakes contain pike in largest numbers and pickerel and whitefish to a lesser extent, while in some of the streams pike and brook trout are plentiful. Among the large land animals the moose, the caribou, and the bear were seen, but no red deer. The latter animal seems to be scarce in all of the Nipigon region, and probably because of its scarcity, wolves are

not so numerous as they are in many other parts of northern Ontario. The small fur-bearing animals are trapped in large numbers during the winter, and among these are mink, marten, muskrat and fisher. The beaver is quite common and the houses, dams, trails and cuttings of this animal were seen in many places. The first flying squirrel which the writer has seen in northern Ontario, was observed in this region.

Among game birds, the partridge and Canadian grouse are plentiful, and some men familiar with the region state that the latter bird often appears in large numbers about the time the snow begins to disappear in the spring. They are then seen feeding on the buds of the bushes along the streams.

Fig. 3. Typical brulé, southern iron range.

#### Surveys

Since this district lies in unsurveyed territory, the chained try-line of the Transcontinental railway proved to be of great service in the preparation of the geological map accompanying this report. Some of the mining claims had been staked out by use of a dial compass, and in that case were quite accurately outlined and have been placed on the map, while others were so badly laid out, on account of the deflection of the compass, that they were of no service in our field work.

This surveyed railway line was used as a base to which the work was tied, but as it did not represent the final line for the railroad it has not been placed on the map. Off-sets were made from the line across the Iron formation outcrops at intervals of 100 to 300 feet, depending upon the complexity of the geological structures. Where the Iron formation was out of reach of the railway line, as in the southern range, a picket

line was run along the range and off-sets made from it. To locate the outcrops near the north and south borders of the map and at some distance from the iron range, north and south lines one mile apart were run by compass and paced to the border of the area, and other lines were run between the first ones mentioned, well out towards the border. The work was checked by running these lines in the form of three sides of a rectangle and always returning to the base line to tie in. As an ordinary compass could not be depended upon over the greater part of the region, the dial was used almost entirely.

## IV.—Physiography

Under this head will be considered (1) the topography and (2) the drainage of the district. Under topography, the three items, the ancient peneplains, the influence of the rocks on topography, and the topography of the drift will be taken up in order.

Fig. 4. Kettle lake in foreground and regular outline of Keewatin hills in the distance.

### Topography

The Onaman area was a portion of the great post-Laurentian and pre-Huronian peneplain. Evidence of this is found in the remnants of this old plain underlying the basal conglomerate of the Lower Huronian in surrounding areas, and in the rocks which make up that basal conglomerate. It has been pointed out by Wilson[3] that a peneplanation also followed the folding of the Huronian, and that the Keweenawan and Cretaceous periods were both followed by great periods of erosion, which developed peneplains in the northeastern portion of our continent. That the area under consideration was concerned in all these changes, and that it must have been several times elevated

[3] A. W. G. Wilson, The Laurentian Peneplain, Jour. of Geol., Vol. XI., 1903.

is shown in the relations of this area to those surfaces overlying the Keweenawan and the Cretaceous rocks in surrounding regions. We have no evidence that since Cretaceous time this region has suffered much change in level, but it has probably been subject to continuous erosion which has so thoroughly worn away the hills that the present surface may be regarded as a characteristic peneplain. The amount of material removed since Keewatin time must have been enormous, as we have no direct evidence that this region has been submerged, and it would appear that some area in this portion of the Archean shield was supplying clastics to the surrounding seas almost constantly after Laurentian time. This great erosion is probably responsible for the fact that the synclines of Keewatin rocks, and particularly the Iron formation, are so shallow and narrow in this northern region.

Fig. 5. Kettle lakes in terminal moraine on Johnson creek.

The present surface is dotted with numerous rounded hills of Keewatin and Laurentian rocks rising through the drift, but none of them have any great elevation above the general level. The altitude of the highest hills in the area mapped is not more than 1,150 feet, while that of the bottoms of the deepest valleys is over 1,000 feet. The surface is very rough, but the relief is low and in all directions one sees for many miles, hills rising to the same general level, and on account of the drift filling many of the valleys the surface of the district is brought nearer a plane (See Fig. 4.) As the highest hills in this area correspond pretty closely in elevation with those of the Keweenawan diabase in the vicinity of lake Nipigon, they appear to represent the remnants of the Cretaceous base-level. In the district covered by the diabase the contours are much more irregular than they are in the Archean region, and the rivers in some places have gorges 400 feet deep where they descend from lake Nipigon to lake

Superior. These deep gorges seem to be due, however, to the streams following new channels because their old valleys have been blocked with glacial drift. Towards the northeast, the peneplain grades down into the coastal plain of the James Bay slope.

The region has been so thoroughly peneplained that the several rock formations have not exerted, on account of varying qualities of resistance, any great influence on the topography of the district as a whole. The greenstones may occur under swamps or in the highest hills. The hard jaspers which have retained a glassy polish since Pleistocene time may have the lowest outcrops of any of the rocks, and while the rhyolites usually form hills, their white color on the weathered surface makes them unduly conspicuous, and one is liable to overestimate their height when looking over the region. The Keweenawan diabases have eroded readily, and the dikes have been worn away as rapidly as the surrounding rocks.

The drift is thick over parts of this area and since the forest fires have denuded it of trees, its topographic features stand out clearly. Its topography is in a youthful stage of development, as the ridges are sharp and many comparatively deep undrained depressions exist. Almost every phase of drift topography is found, from that of the ground moraine with almost level surface, now covered with swamps or muskegs and broken only by small knolls of drift, to the terminal moraines with deep undrained depressions and irregular hills. (Figs. 5, 21 and 22.) Some of these depressions contain lakes, while others are dry and the bottoms of them are as much as 80 feet below the tops of the hills surrounding the basin. Besides the kettle lakes still in existence, there are local clay flats with small streams cutting very youthful gulleys across them, and these areas bear evidence of having been covered by small lakes in the drift, which have since been drained. Eskers and kames are not prominent, although two small examples of the former and a few of the latter were seen. Small outwash plains occur in front of the terminal moraines. The irregular topography around the Height of Land gives place, as one descends the streams leading from it, to plains of sand and clay formed in the shallow waters of the large glacial lakes, Algonquin on the west side of the divide, and Ojibway[4] on the east.

#### Drainage

Two streams of considerable volume rise in this district and control its drainage. These are Johnson creek with several tributaries, two of which, the McCrey and Jeffries creeks are important; and the Red Paint river which has very few tributaries in the Onaman district, but receives several large ones lower down in its course. The former stream rises in a large muskeg saturated with water, and the latter originates in Red Paint lake, a beautifully blue lake, fed by calcareous springs issuing from the drift. They flow in opposite directions and represent the drainage of the Hudson Bay basin and that of the St. Lawrence River basin on either side of the Height of Land. In some places this divide is so inconspicuous that one can travel across it in a swamp from which water issues in opposite directions, and in other places it is represented by a distinct ridge of drift or solid rock. The region, as a whole, is characterized by a great number of swamps and muskegs which are a serious impediment to travel in the wet seasons. The rivers have broad, shallow valleys and meandering courses.

## V.—Geology

#### Outline of the Historical Geology

The rocks of this area may be classified as in the following table. The greenstones, being the oldest, are placed at the base, and the others are arranged in order of their

[4] See Dr. Coleman's paper on Lake Ojibway in this volume.

relative ages. The age of the diorites is not fixed beyond the fact that they are post-Laurentian, and therefore they are placed apart in the classification.

| | | |
|---|---|---|
| CENOZOIC | Recent,—Alluvial deposits and travertine. | |
| | Pleistocene,—Drift and lacustrine sands, silts and clays. | |
| PRE-CAMBRIAN | Keweenawan,—Diabase (dikes). | |
| | (Igneous contact.) | |
| | Huronian,—Hornblende-porphyry (small intrusive masses.) | |
| | (Igneous contact.) | |
| | Laurentian,—Granite and granite-gneiss (batholiths). | |
| | (Igneous contact.) | |
| | Keewatin | Iron formation. |
| | | Rhyolite-tuff, agglomerate and conglomerate. |
| | | Rhyolite, rhyolite-porphyry and feldspar-porphyry. |
| | | Greenstones and green schists. |
| | Post-Laurentian,—Diorite dikes. | |

The geological history of the district begins with the formation of the greenstones, which occupy a very prominent place here, as in almost all other Keewatin areas. On account of their great age and consequent metamorphism, they are now dark to light green from the presence of chlorite, and are often so altered that their original mineral composition cannot be determined. Thus the term greenstone seems to be appropriate for them. A detailed examination shows, however, that they are made up of a complex of basic igneous rocks composed of two types, extrusive and intrusive; the former being characterized by their fine-grained texture and pillow or ellipsoidal structure, and the latter by their granular texture. The only typical extrusive structure observed in this region is the pillow or ellipsoidal structure, which is well developed over considerable areas.

The composition of at least some of the extrusives is that of diabase. The intrusives are represented by greatly weathered gabbros, coarse diabases, augite porphyries and probably other basic rocks. These represent the rocks which formed at depths possibly contemporaneous with the extrusives and which have, in places, been exposed by erosion. From these massive rocks green chloritic schists have been developed by dynamo-regional metamorphism. It is possible that some of these schists have been developed from sediments, but such an origin cannot be established for them.

Following the period when the basic rocks were the predominant product of vulcanism, there was a period when the acid rocks were the prevailing type. It is probable that during the time that the basic rocks were being most prominently formed, some acid rocks also originated, but it is clear that there were periods in which first one and then the other was largely predominant. There are patches of rhyolite here and there in great masses of greenstone, and they are so intimately folded together that their relations cannot be defined, but it is certain that the acid rocks in many places cut the greenstones, and in no case observed do the greenstones cut the acid rocks. Some of the latter rocks are regarded as later than the Iron formation, but none of the greenstones have been so recognized.

So far as can be gathered from the field and laboratory study of these acid rocks, they are largely extrusive in origin. This is shown by their fine-grained groundmass, with very few and small phenocrysts which are often well rounded or eaten into by the absorptive action of the groundmass, possibly upon relief from pressure when the rock reached the surface The phenocrysts are often broken and the spaces between the fragments are filled with the groundmass, as if these had been broken during the movements of the lava. Another evidence of their extrusive character is the fact that they are associated with tuffs, which grade into sedimentary rocks, in such a way that rhyolite

forms the cement of the tuff fragments in a few places, and almost everywhere the tuff overlies the acid rocks. That these rocks are not intrusive into the Iron formation, except in one case, is shown by outcrops of them in the Iron formation where they are always surrounded by a zone of tuffs, showing that they have been folded in from beneath, with the sediment above them. The outcrop of the rhyolite also conforms with the structure of the Iron formation, in that it has the same strike and dip and never cuts across the bands. There is no evidence that extrusive sheets of rhyolite have been interbedded with the Iron formation. It is probable, however, that in some parts of the district volcanic activity continued, because there is a large mass of rhyolite and rhyolite-porphyry cutting off the eastern end of the northern iron range in such a way that it must be considered later than the Iron formation.

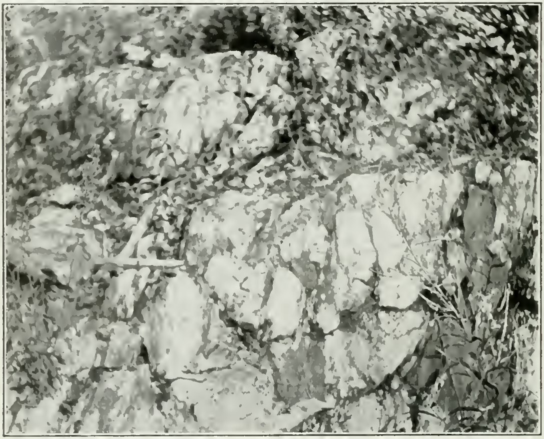


Fig. 6. Agglomerate at the twelfth portage on the Red Paint river, below Holliday lake.

Accompanying the rhyolite, but for the most part a little later than it, there is a series of pyroclastics grading into true sediments. They are composed of tuffs grading through agglomerates or distinctly angular, coarse fragments with a sedimentary matrix, to a rock with the pebbles sufficiently waterworn to be called a conglomerate. The angular type of fragment is, however, largely predominant, and these fragments represent the results of the explosive phase of volcanic activity. (Fig. 6.)

Above the pyroclastics, the Iron formation, consisting of sedimentary deposits, was laid down. In one place a few pebbles or tuff fragments were found lying in a slate near the base of the Iron formation and between narrow bands of jasper. In another place there is evidence that a band of tuff with a sedimentary matrix had been deposited with the Iron formation, as it is difficult to explain the presence of this band on any other supposition. This band may indicate either volcanic activity during the deposition of the Iron formation, or the transportation of a small amount of coarse

material from the surrounding lands where it had previously been deposited by volcanic action.

It is the writer's opinion that the Iron formation was deposited in lakes, some of which were of large size. The reasons for holding this opinion are as follows: (1) The very irregular surface which would be developed during such a great period of igneous activity as that which characterized the Keewatin, would be conducive to the formation of enclosed basins which would tend to increase in depth as the rocks adjusted themselves during the transfer of material from below upward. (2) That there was poor drainage is shown by the lack everywhere in the Keewatin of coarse sediments well water-worn, but that there was weathering action and transportation of materials going on all the time, is evident from the presence of slates of distinctly clastic origin and of graywackés, which grade into fine slates and occur as narrow bands interbedded with jaspers and magnetites. (3) It is clear that land surfaces must have been in the vicinity to supply the above mentioned clastic deposits, always found in the Iron formation. If one considers the distribution of the Keewatin iron ranges in Canada, it is difficult to conceive of the sea covering all the area over which these ranges have been formed, and at the same time leaving sufficient land exposed to supply the clastics. (4) The difficulty of saturating the ocean with iron salts would be obviated and a geological condition more nearly like some conditions existing on the earth at the present time could be postulated.

As time passed, the mountain building thrusts seem to have folded the Keewatin sediments into close folds with their long axes running in a general east and west to northeast and southwest direction. Beneath the anticlines of these folds, the great granite batholiths had a tendency to rise and form the Laurentian granite and gneiss masses so widespread in the Archean of Canada. On the accompanying map it will be observed that the two outcrops of granite and gneiss represented there occur between synclines in the Keewatin sediments.

The forces which folded the sediments, in many places mashed the igneous rocks into distinct schists, with their plane of schistosity as a rule nearly vertical.

After the folding of the Keewatin, the intrusion of the Laurentian, and the consequent metamorphism developed by this intrusion, a great peneplanation began and affected all of the Keewatin-Laurentian shield. During this peneplanation the basal conglomerate of the Huronian was developed, and it includes pebbles of all types of older rocks found within many miles of the point where it was laid down. This rock was not found in the Onaman area, possibly because the continental divide has always been near this region, and very little of the conglomerate was formed here, or because it was formed and since worn away and the materials carried to lower levels. It is well developed along the Sturgeon river, about 45 miles south of this area, and it is probable that this is a portion of a large deposit made in the Nipigon basin during Huronian time. There is evidence of the existence of this basin at an early date, in the presence of the great Keweenawan deposits which filled it, and the remnants of older quartzite and some ancient limestone.

Since the formation of the above mentioned peneplain, we have a rather meagre history of the district. There was a little volcanic activity during the Huronian, as shown by the presence of hornblende-porphyries occurring in small irregular masses which cut the Iron formation, and are themselves cut by the Keweenawan diabase dikes. Two diorite dikes also cut the Iron formation on the Height of Land claims, but beyond the fact that they are post-Laurentian and possibly related to the hornblende-porphyry, nothing can be said about their time of origin.

In the Keweenawan period the great igneous activity of the Lake Superior and Lake Nipigon basins extended as far northeast as the region under discussion. Here there are large diabase dikes running for miles across the country, with persistent strike, and cutting all earlier formations regardless of their nature. There are no

remnants of sheets or sills which would make it appear that these dikes served as channels through which material ascended to form such masses, as similar dikes have served in some other parts of the Nipigon region. As these dikes run in an approximate northwest-southeast direction, and roughly parallel to the lake Nipigon basin, where there was such extensive volcanic activity, it is very probable that the adjustment of the rocks around the basin caused the fissures which became filled from the main diabase magma.

From Keweenawan time until the Pleistocene, there is a lost chapter in the geological history of this area, except what can be read from the results of great periods of erosion in the surrounding rocks. If any rocks were formed here they have since been entirely eroded away. It seems probable that during this time erosion was in progress, continuously, and a Cretaceous peneplain was the result.

In the Pleistocene period the glacier halted here for a long time and left extensive terminal moraines and their accompanying structures. That the ice remained until after lake Algonquin began to subside from its highest level is shown by the absence of beaches or water action on the morainic deposits, while the lake is known to have reached a level higher than that occupied by these deposits, and lake beds can be traced up the Red Paint river to their base. It is therefore evident that the ice formed the northern shore of the lake when it reached its greatest extension.

The only recent deposit of interest is the travertine which is being deposited in and around Red Paint lake and along the stream leading from it. This mineral comes from springs which feed the lake, and arise in the drift from which the calcium carbonate is derived.

### Structure

Under this heading will be considered (1) rock relationships, or the structural relations of the several rock formations to one another; (2) folding; (3) faulting; (4) cleavage; (5) fracture. The sections on the accompanying map will give the reader some idea of the general rock structure of the district.

*Rock Relationships*:—The rock relationships here are extremely complicated because of metamorphism, of the great predominance of igneous rock, and the occurrence of both intrusive and extrusive types. The greenstones consist of deep-seated intrusive rocks, overlain by and intruding into surface flows, and they have again been intruded and overflowed by acid rocks in the form of dikes, bosses, irregular masses, and flows. The consolidated stratified rocks of the region are the thin beds of pyroclastics, which have been in part worked over by water, and the Iron formation. These have in one place been cut through and overflowed by acid eruptives, and later, in Laurentian time, the batholiths of granite which seem to have accompanied the folding at the close of the Keewatin, cut through all the earlier rocks. Some of the Keewatin rocks, including the Iron formation, were, about Huronian time, cut by dikes and irregular masses of rock of medium composition, and in Keweenawan time the diabase dikes cut all earlier rocks, and, in some spots, in an intricate manner. The drift was then deposited over all these during the Pleistocene period.

*Folding*:—Folding occurred on a large scale about the end of the Keewatin period, and two synclines, which represent the minor portions of much larger synclines, are represented by the iron ranges. There seems to have been a tendency for the synclines to develop at the junction between the chief rhyolite and greenstone masses, probably because of a line of weakness there, and of an original depression which would be emphasized during the folding.

There has been extensive folding in some parts of the Nipigon region since Huronian time, and evidences of it may be seen in the folding and mashing of the Huronian conglomerate in the Lake Wendigokan region, on the east side of lake Nipigon. The

post-Huronian folding was not so extensive, however, as that of the post-Keewatin, as there are areas in Ontario where the Huronian is almost undisturbed, but in no place, so far as reported, has the Keewatin been found without intense metamorphism.

That the greater thrusts occurred before the solidification of the Laurentian granite is evident from the facts that this rock is not folded into the same great regular anticlines and synclines as the Keewatin rocks, and is not mashed to nearly the same extent, but has its greatest schistosity developed around the periphery of the batholiths, while the central portion may often be almost non-schistose. To what extent the eruption of the granite was the cause of the folding or the result of it, cannot be decided, but on account of the relations between the granite and the anticlines of the folds, it is probable that the former rose beneath the latter as warping took place, as it appears to have done in more modern mountain building.

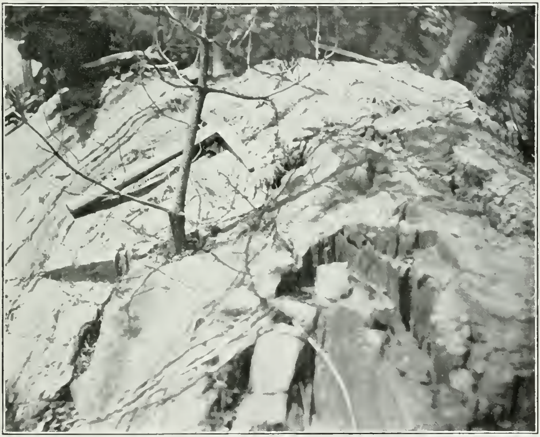


Fig. 7.—Folding and fracturing in the Iron formation of the southern range.

The thrusts producing the major folding were from nearly north and south, judging from the general east and west strike of the axes of these folds. The sediments were closely folded, so that their bedding planes now stand almost vertical, but their dip varies greatly because of the presence of large masses of igneous rock, which produce, on account of superior resistance to folding stresses, local irregularities in the folds of the sediments. The dips run from 55° to 90°, with 70° northward as a common occurrence. Where the dips are less than 90° they must be regarded as those of overturned folds, and in the case of the 55° dip, the fold has been overturned to the extent of 35°. (See structure section on accompanying map.)

Superimposed on the major folds are many minor folds and crumplings, varying even to microscopic size (Fig. 1, Plate 1). The result of the combination of major and minor folds is an extremely complicated structure, and it is impossible to work out

with any degree of satisfaction the thickness of the Iron formation, as beds are often repeated in the most irregular manner. The distinction between some of the rock formations has to be made entirely on a lithological basis.

That the following occurred when the sedimentary rocks were, in most cases, not deeply buried, is evident from the fractured condition of many of the rocks, a good example of which is seen in Fig. 7. and that some minor folding occurred within the zone of flow is illustrated in Fig. 8. This condition was observed on the Miller claims, and it shows a thickening of the beds in the apex of the anticlines and a thinning of them along the limbs. The more brittle jasper bands have been entirely pinched off in the limbs and thickened in the apex of the anticline, while the slates enclosing the jasper bands, being in the zone of flow for slate and more plastic than the jasper, have thinned and thickened without leaving any trace of the dragging which must have occurred during the process. This folding occurred in a horizontal plane normal to the plane of schistosity common to the region, and it is only tributary to the major folding produced by the forces which developed the schistosity.

*Faulting*:—A number of faults were observed in the region, and they were all of the normal type. On the Winter Camp claims two fault planes were seen, which repre-

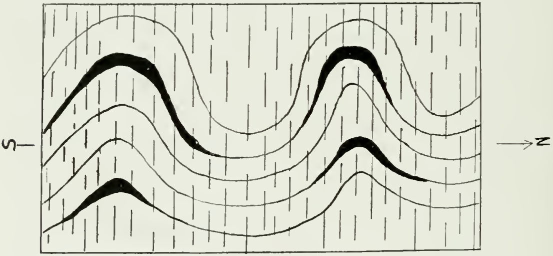



Fig. 8.—Sketch made in the field to illustrate the thickening and thinning of the beds in a minor fold, formed in the zone of flow. Black represents jasper bands in bands of slate. The schistosity is normal to the bedding planes.

sent the most extensive faults of the area. At this point a large block of ellipsoidal greenstone had risen through the Iron formation. The evidences of faulting were distinctly seen in the brecciation of the jasper, and the slickensided surfaces still remaining on the hard jasper.

Connected with the movements and brecciation, there appears to have been deposition of pyrite from solution. This may be seen everywhere as little veins penetrating the greenstone and jasper. The fault plane on the north side of the block appears to be nearly vertical, and information obtained from a drill hole put down at an inclination of 60° to the vertical shows that the dip of the plane is at least 65°, because the hole failed to reach the greenstone at 351 feet, although the distance on the surface of the ground between the drill hole and the greenstone is only 300 feet.

A number of small faults, some of which are indicated on the map, occur in the southern iron range, and they are all either of the dip or oblique type. They are not of great extent and, so far as observed, their planes were vertical and their strike roughly north and south. There are all variations, from the largest faults to those of microscopic size. For a good example of faulting on a small scale see Fig. 2, Plate 1

The age of the faulting seems to be pre-Keweenawan, and it was probably connected with the fissuring which opened the channels now filled with the diabase dikes. Near the eastern end of the southern range a diabase dike is displaced, but at the point of displacement it is broken up into numerous little branches which indicate that the branching of the dike was due to previous faulting, and the fracturing of the rock near the fault.

These displacements brought out one interesting point regarding the relations of the Iron formation and the underlying rhyolite and tuff. In all cases where a dip fault cut across an outcrop of the rhyolite within the Iron formation, the outcrop of the rhyolite was widest on the upthrow side of the plane, thus showing that it widened with depth and therefore that it was not folded down into the Iron formation from above. This condition was seen in several cases, and seemed to establish the relations between the tuffs, rhyolite and Iron formation.

*Cleavage*:—Cleavage is well developed in many of the rocks, although there is a tendency for fracture rather than flow to occur, owing to the rocks not having been deeply enough buried to cause flowage. In the greenstones all gradations between massive rocks and perfect schists can be found, and there are examples within these rocks of unorientated, partly orientated, and completely orientated crystals. When the condition of complete orientation has been brought about, most of the original minerals have completely disappeared and are now represented by sericite, biotite and secondary hornblende. The rocks which have been so completely mashed as to produce a perfect cleavage are generally much weathered and now almost unrecognizable for purposes of lithological classification. A linear-parallel cleavage,[5] *i.e.*, a cleavage parallel to a line, is often developed in the greenstones, and they part into masses more or less hemi-cylindrical.

In the rhyolites a megascopic schistosity is developed, but, on account of the nearly equi-dimensional nature of the feldspar and quartz crystals, no great degree of orientation of the crystals is noticeable. In most cases these crystals have fractured without flowing, and although granulation and some recrystallization has occurred, very little parallel orientation has been effected. In the rock sections in which much sericite or biotite has been developed, considerable orientation has taken place.

In some of the slates a good cleavage is developed; and this is particularly well shown under the microscope by some of the phyllites, or slates bearing much mica, which is arranged with the long axes of the plates parallel.

A fracture cleavage is very common in the jaspers and slates. It occurs on a very small scale in the jaspers, in which from one to three sets of parallel intersecting fractures may be seen with the aid of the microscope. There is, according to Leith, a difference of opinion as to whether this type of cleavage, like flow cleavage, is dependent upon a parallel arrangement of the mineral particles.[6] In the slides examined no relation was found between the fracture lines and the arrangement of the minerals, nor is there always any relation between the bedding planes and the direction of the fractures, though they often follow one another. In slide 112 there is a set of fractures parallel to the bedding planes, another set cuts these at 18°, and a third set at an average of 40°. There is also a set of coarser, irregular fractures cutting the bedding planes nearly at right angles. A series of fractures as described above would be developed by stresses applied in a direction normal to the bedding plains in Fig. 3, Plate I and Fig. I, Plate II., examples of fracture cleavage will be found. In the first of these there is illustrated a series of closely spaced fractures in a jasper, and in the second a good example of two parallel sets of fractures intersecting in an acute angle of 37°. Slipping along one set of fractures has produced a lengthening of the rock section in the horizontal direction through the application of pressure in a direc-

[5] U.S. Geol. Surv. Bull. 239, p 158.  [6] *Ibid*, p. 123.

tion intersecting the obtuse angle at which the fractures intersect. A striking feature about these fractures is that they are almost always filled with quartz, showing that during metamorphic changes the movement of quartz has been a prominent process. With the quartz is often associated sericite, chlorite, carbonates or even a little hematite.

*Fracture*:—In the greenstones a very common feature is a series of open cracks which often subdivide the rocks into nearly rhombic forms and give them a very rough surface. This fracturing is also seen to some extent in the rhyolites, and some of the apparent conglomerates of this region, composed of oval-shaped fragments of rhyolite lying in a matrix of the same material, were thought, in the field, to be formed by the rounding of these blocks. This rounding would be due to movement of the blocks under shearing stresses, as Smyth and Finlay have shown that some of the pseudo-conglomerates of the Vermilion district have been rounded.[7] Some of the conglomerates thought to have been so formed have proved from a microscopic examination of the matrix to be agglomerates and conglomerates and it is probable that they are all of the same origin.

In the jaspers, fracturing instead of flowage often occurred during the metamorphic changes, and there are all gradations between the two processes. Fig. 9 is a sketch made in the field to illustrate the effect of longitudinal thrusts on bands of jasper embedded in slate. The jasper is much harder and more brittle than slate, and requires a deeper burial to place it in the zone of flow, so that in this case the slate was well within its zone of flow while the jasper was on the border of its corresponding zone. The rock was buried deeply enough to cause some flow, but not sufficiently deep to prevent all fracture, and the result has been that certain bands of jasper have become rolled up and portions nipped off, leaving a pseudo-pebble. Fig. 10 is also a sketch from a field observation to show the result of the isolation of one of these autoclastic fragments.

### Metamorphism

Under this heading might be included a description of all those changes which have affected the rocks since their origin, such as folding, mashing, production of cleavage and other structural processes, as well as the weathering, cementation and development of new minerals. Since the structural characters of the rocks have already been considered in the previous sections, and the weathering processes can be best described in connection with individal types of rock, this section will be devoted to a brief discussion of the formation of new minerals in the zones of anamorphism and contact metamorphism. The former are produced under the influences of dynamo-regional agents, and the latter by the intrusions of igneous rocks acting on the older rocks in their immediate vicinity. The two types of metamorphism are superimposed upon one another, and the results of the different types are not always readily discriminated. It is also difficult to distinguish some of the minerals which are the products of weathering from those which have resulted from dynamo-regional metamorphism, or from the two combined.

*Dynamo-regional Metamorphism*:—The greatest changes produced by this type of process are probably the development of quartz from chert, magnetite and hematite from siderite, actinolite from ankerite, and biotite from the iron minerals, while the origin of epidote, zoisite, apatite, dumortierite, garnet and tourmaline cannot always be definitely fixed. Some of the garnet is due to contact action, and it seems reasonable to regard the greater part of the tourmaline as of fumarole origin; but both of these minerals are probably produced in some cases by dynamo-regional influences.

The most interesting mineral formed in this connection is dumortierite, a rare mineral and one never before reported from the Iron formation. On account of its rarity it is given special consideration.

[7] Eng and Min. Jour., Vol. XXV., p. 629.

*Dumortierite*:—This is a basic silicate of aluminium, having the composition ($Al_{20}$ $Si_{17}$ $O_{14}$) or $Al_2$ $O_3$, 70.8 per cent., $SiO_2$ 29.2 per cent. Part of the alumina may be replaced by boron, but in this case no analysis for boron was made.

The mineral, as examined, has the following characters: It is orthorhombic. It occurs in distinct prismatic and fibrous crystals, or as irregular grains or plates with terminal faces which in very small crystals can be recognized as pyramidal. In all previous descriptions of this mineral no terminal faces have been recognized. The prismatic angle is over 55°. The cleavage is prismatic and quite distinct. Fractures normal to the prism are very prominent, and a rather imperfect zonary development was recognized in cross section. Optically negative with the axial plane parallel to (010). The acute bisectrix X[8] is normal to (001); X is parallel to c; Y to b and Z to a. The maximum birefringence for blue and violet is .014. Elongation is negative.

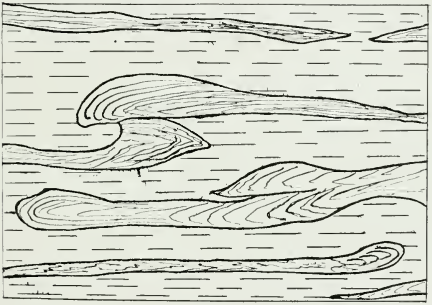


Fig. 9.—Sketch made in the field to illustrate the effects of longitudinal thrusts applied to bands of jasper interbanded with slate. The rock has been sufficiently near the zone of flow to permit some flowage, but not near enough to eliminate all fracturing Scale 1 inch = 3 feet.

The color is a deep sky blue or a phase of Prussian blue. In this section the mineral is strongly pleochroic; colorless to deep blue. X is deep sky blue, Y violet or reddish violet, Z colorless to slightly yellow.

The mineral occurs only over a very limited area in the Iron formation on the Miller claims in the northern range, but it was found in two hand specimens from the area, and three thin sections have been examined. In slide 50 it occurs in a very dark bluish magnetite slate, properly called a dumortierite-magnetite slate, which had been highly metamorphosed. The only minerals present in this rock are quartz crystallized from chert, magnetite, hematite and dumortierite. The iron oxides appear to compose about 65 per cent. of the rock, the dumortierite 20 per cent. and the quartz 15 per cent. It is fine-grained, and the longest prism of dumortierite is 0.78 mm. in length. The mineral occurs all through the chert, and its growth is often interfered with by the magnetite somewhat after the nature of the occurrence of minerals in a contact metamorphic deposit. There is, however, no definite evidence in the field of contact action and there are no distinctive contact minerals associated with it, and the mineral

[8] Iddings, Rock Minerals.

is, to all appearances, a product of dynamo-regional metamorphism. A chemical analysis of the rock made by Mr. N. L. Turner, Provincial Assayer, Belleville, gave the following:

| — | Per cent. | — | Per cent. |
|---|---|---|---|
| $SiO_2$ | 26.72 | MnO | Trace |
| $Fe_2O_3$ | 23.19 | $CO_2$ | ......... |
| FeO | 19.61 | $P_2O_5$ | 0.05 |
| $Al_2O_3$ | 26.85 | $K_2O$ | 0.92 |
| CaO | Trace | $Na_2O$ | 1.35 |
| MgO | " | Moisture | 0.85 |

The most striking feature of this analysis is the very high percentage of $Al_2O_3$. The analyses of slates and shales from various sources do not contain, on an average, more than 16 per cent. to 17 per cent. of this oxide, and no other mineral than dumortierite can supply so much of it. As the mineral is secondary, it has evidently derived its alumina from kaolin resulting from a thorough weathering of feldspars, and

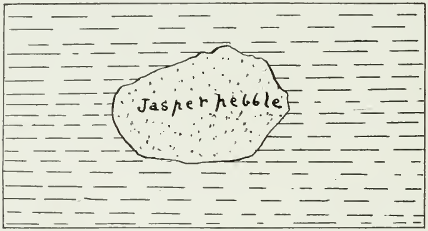



Fig. 10.—Sketch showing an autoclastic fragment of jasper developed by the rolling up and pinching off of a band similar to those in Fig. 9. This illustrates a more advanced stage of the process. Natural size.

a concentration of the products during the formation of the enclosing rock. An investigation of many analyses of clays, compiled by Ries[9], shows that most of these do not contain more than 20 per cent. of $Al_2O_3$, but that a number exceed 40 per cent. That this is the source of the alumina is supported by an examination of the other two slides, one of which is made from a jasper grading in to a slate (Fig. 2, Plate III), and the other from a banded slate and fine-grained graywacké containing a little magnetite, some siderite partly altered to limonite, much pyrite, some clastic and cherty quartz, apatite, and a good deal of considerably altered unstriated feldspar. The dumortierite occurs scattered universally throughout the section and does not seem to be related to any of the other minerals. It cuts across fractures filled with quartz derived by crystallization of chert from the groundmass. In this section the crystals are not so distinctly prismatic as in the others, and the mineral usually occurs in irregular crystal forms.

The occurrences of dumortierite in other places are comparatively rare. It has been reported from several districts where it was found occurring in granite-pegmatite and in gneiss. It has also been found in a quartz rock. Tourmaline, cordierite and apatite have been found associated with it. In the present case no tourmaline occurs

[9] Clays, Occurrence, Properties, and Uses.

in the dumortierite-bearing rocks, but it is found in small quantities at a short distance from them and in rocks of several types. Apatite is associated with it here.

The other minerals formed by this type of metamorphism do not deserve particular attention beyond an actinolite-magnetite rock which, in one case, was found representing a narrow band of Iron formation. It seems to have been formed from ankerite and chert, which were present in such proportions that all the silica entered into the constitution of the actinolite.

Biotite makes up a large percentage of the phyllites which have been developed where the slates contained a good deal of iron.

Garnets are not common outside of contact zones, and in the one case where they are well developed and their origin is in doubt, they are probably due to contact action, although the intrusive could not be definitely placed. They are associated with a good deal of tourmaline and a little actinolite, and the rather vitrified nature of the slate in which they occur indicates that they are due to a mass of rhyolite-porphyry, which is probably connected with a larger mass considered later than the slate, and which shows as a low outcrop not far away. The slate occurs on the border of a swamp southeast of the Miller claims.

Although tourmaline is widely scattered throughout the region, it is probably due to the after action of the acid magma, and it will be considered under the heading "Contact Metamorphism," which immediately follows.

The development of magnetite from siderite, with a reduction of volume in the iron compound and a transfer of silica to fill the rhombic space formerly occupied by the siderite, is well illustrated in Figs. 2 and 3, Plate II.

*Contact Metamorphism*:—There are two areas which contain particularly distinct contact results. These are, as already mentioned, situated on the ninth, or "Red" portage of the Red Paint river and on Ste. Marie's lake along the National Transcontinental railway line, about 8 miles west of Wilgar lake. The latter area is locally known as Trombley's claims, because a prospector by that name has staked some claims on the Iron formation there.

In the former of these areas a large batholith of Laurentian granite has intruded the greenstones, green schists and a little lean Iron formation, causing alterations decreasing in intensity for about a quarter of a mile from the granite where they die out. From the greenstones and green schists, garnetiferous schists have been developed and from the Iron formation, actinolite-magnetite-quartz schists. The garnetiferous schist possesses a banded structure with pink to purple garnets developed along certain bands. It is very hard and appears to have been baked. In thin section, a typical contact rock is seen, which has been developed by the contemporaneous development and intergrowth of garnet, cyanite, calcite and blue-green hornblende. No actinolite was seen in this slide, but it occurs in other parts of the same rock. In some cases the garnet completely encloses grains of cyanite.

The actinolite-magnetite-quartz schists show that they have been developed by the crystallization of chert into a mass of quartz crystals fitting closely together and often six-sided, and by the alteration of ankerite and quartz to actinolite. A thin film of iron oxide occurs along the borders of the quartz crystals, and the actinolite needles run along the borders or cut directly across them. Twinning is very highly developed in the amphibole, and one striking feature is the distinct cleavage cutting across the twinning planes at an angle of 20°. This is due to the particular manner in which the section happens to be cut. Chlorite and sericite occur along veins, and in one case a vein of magnetite and actinolite cuts across the section. It appears that this vein has been developed by the alteration of iron carbonate.

As a result of the intrusion, a great deal of pyrite is found in the surrounding rocks, and it is widely disseminated through them. It is largely altered to limonite, which has stained the hills red and has been responsible for the staking of a number of claims in this vicinity by the Algoma Commercial Company, and for the naming of this portage on the river, the "Red" portage.

On the Trombley claims a large mass of diabase has broken into the Iron formation, brecciating it and filling the cracks with pyrite. Along the contact, weathering has been rapid, and Ste. Marie's lake obscures the real relations between the diabase and older rocks. On the east side of this lake a band of very lean Iron formation about 500 feet wide stretches eastward, and in it a good deal of pyrite and some pyrrhotite have been deposited as secondary constituents. These two sulphides are intimately intermixed, but the pyrrhotite is confined pretty closely to the border of the lake, and the outcrop disappears beneath it. The conditions show that the pyrrhotite is closely related to the diabase in some way, and suggest that the pyrrhotite is the direct product of the diabase magma deposited either in the form of a magmatic segregation, as a contact deposit, or as a combination of the two.

The Iron formation has been altered to grünerite and actinolite-magnetite-quartz schists. In thin section the silica is seen to be well crystallized, often into distinct hexagonal crystals, and scattered through it are rhombs of ankerite or siderite partly or completely altered to actinolite. (Fig. I, Plate III). In the alteration of the carbonate there is often a thin zone of fine-grained magnetite near the border of the rhomb, with the interior filled with a skeletal structure of fine needle aggregates of actinolite, and little needles radiate from the border of the rhombs, giving them a fuzzy appearance. The magnetite crystals are mostly restricted to narrow bands in the quartz, and where they occur the quartz grains are very small, making it appear as if the presence of the magnetite prevented the most complete crystallization of the chert. This feature has probably played a role in preventing the coarse crystallization of many of our fine jaspers, as there seems to be, in most cases, some relation between the percentage of the iron oxide in the rock and the degree of coarseness in the crystallization which has occurred.

The contact effects, superimposed on weathering and dynamo-regional changes, have produced extensive alterations in a rhyolite occurring in this area. Remnants of orthoclase crystals remain in places, but, in other cases, the outlines are indicated by the presence of sericite, kaolin and quartz. Biotite is developed to a considerable extent, as well as a deep bluish-green hornblende, in small crystals, and often in a somewhat irregular radiating arrangement The hornblende and biotite are intergrown. A good deal of chlorite, epidote and some zoisite have been developed by weathering and contact action, and, in one section, a large number of garnets were found. The latter are intergrown with the groundmass, with quartz, with hornblende, with chlorite, and, in some cases, they penetrate the remnants of feldspar phenocrysts. The zoisite occurs in grains and in long slim prisms. One small crystal of almost colorless enstatite was found. Little apatite crystals are very numerous.

The groundmass has almost entirely recrystallized and there has been a tendency for the quartz to segregate into little bunches of crystals. A fracture cleavage has been developed in the groundmass, and the parallel fractures filled with calcite and sericite. One small vein of lime-soda feldspar, containing a number of grains of epidote, cuts across the section. The materials for this vein appear to have been derived from the groundmass.

The diabase dikes cutting through the Onaman region seem to have had very little influence on the rocks in contact with them, and this condition is surprising when one considers that some of these dikes are as much as 150 feet in width. They have cut the Iron formation without reducing the hematite close to them to magnetite. The only noteworthy contact effect is seen in the large amount of epidote which has been

developed. It occurs in crystallized form in little veins in the vicinity of the dikes or, as may be seen in the thin section, it is widely disseminated through the surrounding rocks as innumerable small crystals.

The absence of more extensive contact effects may be ascribed to the comparatively cool condition of the magma when it was intruded into the older rocks, or to the intrusions occurring at comparatively shallow depth where the accompanying gases and solutions readily volatilized. The contact effects of the Keweenawan diabase in the Nipigon region as a whole vary greatly; as a rule it has had little effect on the surrounding rocks, but in some cases it has produced very extensive alterations.

*Tourmaline*:—This mineral is widely distributed in the region, and occurs in several types of rock. Some of it may be due to dynamo-regional metamorphism, but it seems more probable that it is the result of fumarole action, occurring as the after effects of the acid magma which formed the rhyolites and rhyolite-porphyries. Tourmaline has rarely been found in extrusive igneous rocks, and this seems natural because the conditions under which these rocks are formed would permit the ready escape of boron-bearing gases. It appears from the field relations of the tourmaline-bearing rocks that the gases which contained boron arose in different parts of the area, mineralizing some of the rocks, and some of these again much more than others. The mineral occurs in rhyolites, in slates, in graywackés and, to a slight extent, in the matrix of the conglomerate. It occurs in the slates of both the iron ranges and in the rhyolite near the southern range. A little is found in the rhyolite lying between the ranges and in the conglomerate on the Miller claims. It is not found in the jaspers, but occurs in the slates of the Iron formation, which contain a good deal of magnetite and grade over into the jaspers.

The age and source of this tourmaline are difficult to establish. That it is later than the rhyolites in one case is evident from a thin section of rhyolite from the southern range, in which it occurs in little grains and prisms arranged along a plane of schistosity where considerable weathering has occurred. It is entirely limited to the plane of shearing. In another case, the secondary nature of the mineral is not so certain. It is found widely scattered through the section in prisms varying in size from 1.17 mm. in length and 0.05 mm. in width, to extremely small dimensions. The crystals are euhedral and have clear-cut edges. They have been greatly dragged and broken by fractures normal to the prism axis (Fig. 3, Plate III). This breaking shows that these crystals were formed before the development of the schistosity evident in the rock, and they strongly suggest crystals of primary origin. They may be primary, but the fact that this rock has the characters of a re-crystallized extrusive and is greatly weathered, goes to show that the tourmaline cannot be definitely regarded as a pyrogenetic mineral, as it may have been introduced by mineralizers. They have not any definite relation to the feldspars as in many other regions, where they are found replacing feldspar crystals.

The only place where tourmaline has been reported as primary in an extrusive rock is mentioned by Iddings, who found it in spherulites of the rhyolite in Obsidian Cliff[10], and he points out that although the mineral is the product of fumarole action, this action may take place either before or after the solidification of the rock. That this mineral in the Onaman region is the product of the fumarole action of the magma which produced the rhyolite, seems to be probable, because there appears to be no other source for it unless it be the Laurentian granite. The distribution of the granite is not, however, so far as can be detected, related to that of the tourmaline. Although tourmaline is more likely to be associated with granite than any other rock, it may be the product of some rhyolite-porphyries or quartz-porphyries, as it has been found in these rocks and in felsites. Weed and Pirsson[11] have found it in the former, and

[10] Bull. Phil. Soc., Washington, Vol. XI., p. 455.

[11] Weed and Pirsson, Bull., 139, U. S. Geol. Surv., pp. 99-102.

As a result of the intrusion, a great deal of pyrite is found in the surrounding rocks, and it is widely disseminated through them. It is largely altered to limonite, which has stained the hills red and has been responsible for the staking of a number of claims in this vicinity by the Algoma Commercial Company, and for the naming of this portage on the river, the "Red" portage.

On the Trombley claims a large mass of diabase has broken into the Iron formation, brecciating it and filling the cracks with pyrite. Along the contact, weathering has been rapid, and Ste. Marie's lake obscures the real relations between the diabase and older rocks. On the east side of this lake a band of very lean Iron formation about 500 feet wide stretches eastward, and in it a good deal of pyrite and some pyrrhotite have been deposited as secondary constituents. These two sulphides are intimately intermixed, but the pyrrhotite is confined pretty closely to the border of the lake, and the outcrop disappears beneath it. The conditions show that the pyrrhotite is closely related to the diabase in some way, and suggest that the pyrrhotite is the direct product of the diabase magma deposited either in the form of a magmatic segregation, as a contact deposit, or as a combination of the two.

The Iron formation has been altered to grünerite and actinolite-magnetite-quartz schists. In thin section the silica is seen to be well crystallized, often into distinct hexagonal crystals, and scattered through it are rhombs of ankerite or siderite partly or completely altered to actinolite. (Fig. 1, Plate III). In the alteration of the carbonate there is often a thin zone of fine-grained magnetite near the border of the rhomb, with the interior filled with a skeletal structure of fine needle aggregates of actinolite, and little needles radiate from the border of the rhombs, giving them a fuzzy appearance. The magnetite crystals are mostly restricted to narrow bands in the quartz, and where they occur the quartz grains are very small, making it appear as if the presence of the magnetite prevented the most complete crystallization of the chert. This feature has probably played a role in preventing the coarse crystallization of many of our fine jaspers, as there seems to be, in most cases, some relation between the percentage of the iron oxide in the rock and the degree of coarseness in the crystallization which has occurred.

The contact effects, superimposed on weathering and dynamo-regional changes, have produced extensive alterations in a rhyolite occurring in this area. Remnants of orthoclase crystals remain in places, but, in other cases, the outlines are indicated by the presence of sericite, kaolin and quartz. Biotite is developed to a considerable extent, as well as a deep bluish-green hornblende, in small crystals, and often in a somewhat irregular radiating arrangement. The hornblende and biotite are intergrown. A good deal of chlorite, epidote and some zoisite have been developed by weathering and contact action, and, in one section, a large number of garnets were found. The latter are intergrown with the groundmass, with quartz, with hornblende, with chlorite, and, in some cases, they penetrate the remnants of feldspar phenocrysts. The zoisite occurs in grains and in long slim prisms. One small crystal of almost colorless enstatite was found. Little apatite crystals are very numerous.

The groundmass has almost entirely recrystallized and there has been a tendency for the quartz to segregate into little bunches of crystals. A fracture cleavage has been developed in the groundmass, and the parallel fractures filled with calcite and sericite. One small vein of lime-soda feldspar, containing a number of grains of epidote, cuts across the section. The materials for this vein appear to have been derived from the groundmass.

The diabase dikes cutting through the Onaman region seem to have had very little influence on the rocks in contact with them, and this condition is surprising when one considers that some of these dikes are as much as 150 feet in width. They have cut the Iron formation without reducing the hematite close to them to magnetite. The only noteworthy contact effect is seen in the large amount of epidote which has been

developed. It occurs in crystallized form in little veins in the vicinity of the dikes or, as may be seen in the thin section, it is widely disseminated through the surrounding rocks as innumerable small crystals.

The absence of more extensive contact effects may be ascribed to the comparatively cool condition of the magma when it was intruded into the older rocks, or to the intrusions occurring at comparatively shallow depth where the accompanying gases and solutions readily volatilized. The contact effects of the Keweenawan diabase in the Nipigon region as a whole vary greatly; as a rule it has had little effect on the surrounding rocks, but in some cases it has produced very extensive alterations.

*Tourmaline*:—This mineral is widely distributed in the region, and occurs in several types of rock. Some of it may be due to dynamo-regional metamorphism, but it seems more probable that it is the result of fumarole action, occurring as the after effects of the acid magma which formed the rhyolites and rhyolite-porphyries. Tourmaline has rarely been found in extrusive igneous rocks, and this seems natural because the conditions under which these rocks are formed would permit the ready escape of boron-bearing gases. It appears from the field relations of the tourmaline-bearing rocks that the gases which contained boron arose in different parts of the area, mineralizing some of the rocks, and some of these again much more than others. The mineral occurs in rhyolites, in slates, in graywackés and, to a slight extent, in the matrix of the conglomerate. It occurs in the slates of both the iron ranges and in the rhyolite near the southern range. A little is found in the rhyolite lying between the ranges and in the conglomerate on the Miller claims. It is not found in the jaspers, but occurs in the slates of the Iron formation, which contain a good deal of magnetite and grade over into the jaspers.

The age and source of this tourmaline are difficult to establish. That it is later than the rhyolites in one case is evident from a thin section of rhyolite from the southern range, in which it occurs in little grains and prisms arranged along a plane of schistosity where considerable weathering has occurred. It is entirely limited to the plane of shearing. In another case, the secondary nature of the mineral is not so certain. It is found widely scattered through the section in prisms varying in size from 1.17 mm. in length and 0.05 mm. in width, to extremely small dimensions. The crystals are euhedral and have clear-cut edges. They have been greatly dragged and broken by fractures normal to the prism axis (Fig. 3, Plate III). This breaking shows that these crystals were formed before the development of the schistosity evident in the rock, and they strongly suggest crystals of primary origin. They may be primary, but the fact that this rock has the characters of a re-crystallized extrusive and is greatly weathered, goes to show that the tourmaline cannot be definitely regarded as a pyrogenetic mineral, as it may have been introduced by mineralizers. They have not any definite relation to the feldspars as in many other regions, where they are found replacing feldspar crystals.

The only place where tourmaline has been reported as primary in an extrusive rock is mentioned by Iddings, who found it in spherulites of the rhyolite in Obsidian Cliff[10], and he points out that although the mineral is the product of fumarole action, this action may take place either before or after the solidification of the rock. That this mineral in the Onaman region is the product of the fumarole action of the magma which produced the rhyolite, seems to be probable, because there appears to be no other source for it unless it be the Laurentian granite. The distribution of the granite is not, however, so far as can be detected, related to that of the tourmaline. Although tourmaline is more likely to be associated with granite than any other rock, it may be the product of some rhyolite-porphyries or quartz-porphyries, as it has been found in these rocks and in felsites. Weed and Pirsson[11] have found it in the former, and

[10] Bull. Phil. Soc., Washington, Vol. XI., p. 455.

[11] Weed and Pirsson, Bull., 139, U. S. Geol. Surv., pp. 99-102.

Lawson[12] in the latter rocks. A slide from a rhyolite-porphyry lying between the iron ranges contains two small crystals of bluish-green tourmaline, which are, to all appearance, of primary origin. As some of these rocks are regarded as later than the Iron formation, they could supply the boron-bearing gases to produce this mineral in all the rocks in which it is found, and this is the probable source of it.

In the slates the tourmaline crystals are small and are arranged with their long axes running in all directions, thus showing that they could not have been laid down as clastic fragments in the slate.

In the one case where this mineral was found in the matrix of the conglomerate, it forms a few crystals and grains, mostly with rather ragged outlines, and is, in every case, surrounded by irregular masses of pyrite. The latter mineral in some places fills cracks in the tourmaline crystals. It may be noted in this connection that Lawson found tourmaline in a felsite from the Lake of the Woods region, and the crystals of this mineral occurred most commonly around grains of pyrite. The only reason which I can assign for the occurrence of these two minerals together is that possibly the crack or other opening which permitted the penetration of the boron-gases into the rock also permitted the permeation of pyrite-bearing solutions.

In a slate occurring on the border of a swamp a short distance southeast of the Miller claims, tourmaline is associated with numerous pink garnets. The other minerals present are zoisite, epidote, pyrite widely disseminated in little specks, and an aggregation of small actinolite crystals. The slate is hard and close-grained and the mineral associations suggest contact action, even though the individual minerals are not intergrown to the same extent as they are in some other established contact zones. No igneous mass can be seen close to this slate, but about a quarter of a mile away a low outcrop of rhyolite-porphyry was found. It is probably related to the large mass a little farther east, which is regarded as later in age than the slates, and the contact action observed in the slate may be due to a mass of this rock occurring in the immediate vicinity but concealed from view by drift.

There is a considerable variety in the color of the tourmaline in different parts of the area, and there does not seem to be any relation between the type of rock in which the tourmaline occurs and its color. The colors observed vary from nearly colorless to dark brown and blue. The pleochroism noted in the brown varieties is brown to bluish brown for O and almost colorless to bluish-yellow for E. In a bluish-brown variety the colors are bluish and pale reddish-violet, and in a blue variety O is blue and E bluish-brown to bluish-violet.

## The Rock Formations in Detail

It is proposed to treat the different rock formations in detail, beginning with the oldest and considering them in order to the youngest. The igneous rocks will be discussed with regard to (1) their distribution, (2) their structural relations, and (3) their petrographical characters; and the sediments in regard to (1) their distribution, (2) their stratigraphic relations, (3) their thickness, (4) their origin, and (5) their petrography.

### The Greenstones and Green Schists (Basic Rocks)

The Greenstones and green schists are the most widely distributed of any rocks of the region, and they are equivalent in general characters to the Keewatin basic rocks in many other parts of the continent. Their descriptions correspond closely with those given by Clements for the Ely greenstones of Minnesota, by Coleman and Willmott for the Gros Cap greenstones of Michipicoten, and by Miller for those of the Cobalt region. They form the base through which the other rocks have risen to the surface and upon which they have been deposited. They constitute a complex series of intrusive and

[12] Lawson, Can. Geol. Sur. Rep., Vol. I., 1885, p. 34 c.c.

extrusive origin. They have been subjected to great dynamic influences, which have developed schists in some of them and altered them in so many ways that the individual minerals and therefore the individual rocks are often undeterminable.

The greenstones and green schists are classed together because it is impossible to separate them on a map. Many of the chlorite schists whose origin would otherwise be unrecognizable may be traced with all gradations into nearly massive greenstones. There is, however, no case where the greenstones do not possess a considerable amount of schistosity.

That some of these schists represent mashed sediments or pyroclastic rocks is possible, because their origin could no longer be determined.

Regarding the relations between the greenstones and the later rocks, it may be stated that in no case was any member of the former series found cutting the acid rocks, and the jaspers were never found directly in contact with them except where this relation was the result of faulting. A good example of the latter condition may be seen on the Winter Camp claims, where the greenstone has been greatly brecciated and an infiltration of pyrite in little veins has occurred.

#### Petrography of the Basic Rocks

*Megascopic Characters*:—The megascopic characters of these rocks are: a dark to light green color, on account of the presence of much chlorite; a large content of calcite in little veins or in holes due to weathering; and the ellipsoidal or pillow structure. The latter is seen where the greenstones have retained their massive nature sufficiently for this structure to be identified. That this is a distinctively extrusive character is shown by the fact that in the Poplar Lodge region on Lake Nipigon it occurs in association with amygdaloidal and flow-breccia structures in Keewatin rocks, and in the Vermilion district of Minnesota with spherulitic structures. It is very common in the greenstones of the Onaman region, and is found over wide areas. The structure has often been described from other areas, and its origin is regarded as due to the rolling of lava as it cooled and flowed along. The dark streaks separating the pillows consist of fine-grained decomposed rock containing a mixture of iron oxide, chlorite and other products of weathering action, while the pillows themselves consist of more or less schistose greenstone. The pillows vary in size from three inches to four feet in length. Fig 11 is a typical example of this structure.

*Microscopic Characters*:—Microscopic work on these rocks is unsatisfactory because of the great alterations which they have suffered. A number of thin sections from specimens taken in different portions of the district showed three greatly weathered gabbros or closely related rocks, two of diabase, one of much altered augite-porphyry and several other basic, chloritic rocks too much metamorphosed to be identified.

A thin section of a rock taken as a type of the greenstones without pillow structure showed a diabase of medium grain with saussuritized feldspars giving rise to kaolin and zoisite. Considerable accessory or possibly secondary pyrite, generally altered to limonite or little specks of hematite occurs, and a greenish secondary hornblende, often becoming almost colorless, is frequently found. The latter mineral has weak pleochroism and often consists of fibrous aggregates (*Strahlstein*) with low polarization colors. This type of amphibole is very common in these rocks and represents an alteration product of hornblende. It resembles actinolite in some respects and may be a variety of it. Other minerals present are quartz, zoisite and epidote. These are all products of weathering. In the gabbros, leucoxene developed from ilmenite is very common. The greenstones with pillow structure are very fine-grained, and little information regarding their fabric or their minerals could be obtained from the thin section.

Where any distinction could be made between the rates of weathering of different minerals, the feldspars were found to alter more rapidly than the ferro-magnesian minerals.

**Rhyolites and Rhyolite-Porphyries or Quartz-Porphyries (Acid Rocks)**

*Relations to other formations*:—It was impossible to determine whether the line of separation between the basic and acid rocks occurring here was distinct, or whether there was a rather gradual transition from one type of rock to the other. That the greater part of the acid rocks were the distinct successors of the basic rocks is shown

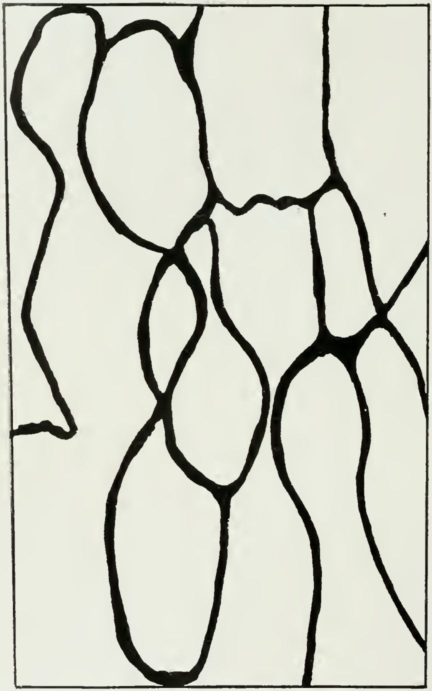


Fig. 11.—Sketch of ellipsoidal or pillow structure in greenstone. Scale 1 inch = 1 foot. (Compare Clements, U.S. Geol. Surv., Mon. XLV., Pl. IV.)

by the fact that the greenstones were never found cutting the rhyolites or acid porphyries, but the porphyries cut the greenstones in many places. The two are often so folded and mixed up together that their relations cannot be definitely

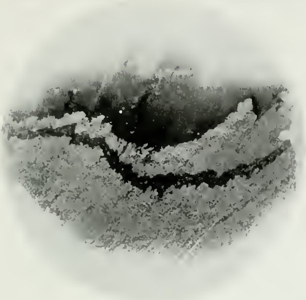


Fig. 1

Fig. 1.—Photograph of thin section 75, showing minor folds developed in a banded slate.
Natural size x 2½.

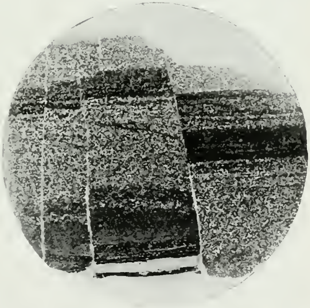


Fig. 2

Fig. 2.—Photograph of thin section 74, showing minor faults in a carbonate slate. The fractures are filled by calcite cement.
Natural size x 2½.

Fig. 3

Fig. 3.—Photomicrograph of thin section 55, showing fracture cleavage in jasper. The fractures are filled with cherty quartz.
Natural size x 35.

PLATE I.

re-absorption of the phenocrysts, larger and more numerous phenocrysts and a slightly coarser groundmass.

The feldspar-porphyries are rare, but one example was found in a dike cutting the greenstones. The description of individual sections will bring out the differences in the types.

*Megascopic Characters*:—The distinctly rhyolitic types vary from a yellowish-green aphanitic mass to a dark gray crypto-crystalline mass with small phenocrysts of quartz and feldspar. The former type resembles a perfectly silicified rock with the appearance of horn. Both types weather almost white, with small spots of brown ferro-magnesian minerals, and in some cases a thin white coating of something like an efflorescence of magnesium or calcium carbonate may be rubbed off. The fracture is sub-conchoidal, and a platy cleavage has been developed in most cases.

In the feldspar-porphyry type, which was taken from a dike, the rock is dark gray and spotted with numerous dull white phenocrysts of feldspar and a good many of dark mica. It weathers a dirty white and has an irregular fracture.

The rhyolite-porphyry type has, in the hand specimen, a more granular look than the rocks described above and the crypto-crystalline groundmass is crowded with phenocrysts of quartz and feldspar. Some of the quartz crystals are as much as 5 mm. in diameter. The color on fresh fractures gives a sort of a pepper-and-salt effect. Weathered surfaces are white.

*Microscopic Characters*:—These rocks all have a porphyritic texture and a holocrystalline groundmass, the latter developed by re-crystallization under metamorphic agencies. The groundmass is usually crypto-crystalline, but varies in some cases to micro-crystalline. In almost all cases the phenocrysts have been broken during the metamorphic processes and the cracks filled with sericite or calcite, or both. In some ot the rhyolites the crystals have been pulled apart and the spaces between the fragments filled with the regular groundmass, in such a way as to indicate that this process took place during the extrusion and movement of the molten rock. The proportion of quartz, orthoclase and plagioclase phenocrysts varies greatly. In some slides no quartz crystals occur, in some plagioclase and orthoclase are nearly equal, and in others all three may be well represented. The quartz phenocrysts sometimes contain mineral inclusions The phenocrysts of both quartz and feldspar are very often rounded or gouged by the groundmass (Figs. 2 and 3, Plate IV).

#### Rhyolite

A thin section of the above mentioned rhyolite, which, in the hand specimen, has the appearance of horn, shows the following characters: The phenocrysts have been greatly crushed, so that now they are represented by irregular aggregates of microcline with quartz from the groundmass intergrown with it along the borders of the crystals. By this intergrowth a resemblance to graphitic intergrowth is produced. The remains of these phenocrysts reach a maximum size of 0.54 mm. by 0.3 mm. Besides these larger ones, there are some small fresh-looking orthoclase crystals, showing Carlsbad twins and not more than 0.108 mm. by 0.08 mm. in size. These may have developed by the re-crystallization of the groundmass.

It has been observed that microcline occurs in the rocks which have been subjected to very great pressure. This would indicate that the microcline twinning may be due to pressure, as some petrographers have suggested.

The groundmass of the above mentioned rock is crypto-crystalline, with portions micro-crystalline, or so finely crystallized that the microscope only shows that it is crystalline by its aggregate polarization. It is composed of quartz, orthoclase and a great deal of very fine scales of sericite.

#### Tourmaline-bearing Rhyolite

A thin section (17) from the rhyolite underlying the Iron formation on the southern range is interesting because of the large amount of tourmaline it contains (Fig. 3, Plate III). This section contains 14 phenocrysts of orthoclase and microcline, varying in size from 1.97 mm. by 1.18 mm. to 0.5 mm. by 0.3 mm. They do not compose more than 5 per cent. of the rock, and some of them have been greatly mashed and broken. The groundmass is considerably weathered to sericite, and although most of it is crypto-crystalline some portions are micro-crypto-crystalline. Cutting across the planes of schistosity there are lines similar to lines of flow, which have produced a pseudo-banded structure. It is impossible to say whether this banding is a remnant of flow structure or not, as the rock has been so much crushed that this may be a type of false cleavage. A little apatite and iron oxide are present.

The tourmaline in this rock is in euhedral crystals varying in size from 0.98 mm. by 0.098 mm. to almost sub-microscopic. They are scattered through the groundmass and lie in all directions. They have been greatly broken and dragged during the development of schistosity in the rock. They do not seem to have any relation to the feldspars, and do not replace them as tourmaline frequently does in other rocks when it is of secondary origin. This mineral probably composes 1 per cent. of the rock. The color is brown to bluish-brown and the pleochroism strong; O bluish-brown and E pale reddish-violet.

The probable source of this tourmaline is discussed fully under tourmaline in the section on Contact Metamorphism.

#### Rhyolite-Porphyry or Quartz-Porphyry

The following characters were observed in a good example (slide 196) of rhyolite-porphyry which occurred along the north side of Castor lake as an apparent intrusive mass of irregular outline. A very finely granular groundmass contains numerous phenocrysts of orthoclase, plagioclase, and quartz. The phenocrysts have been crushed and broken, and the quartz crystals show considerable re-absorption by the groundmass (Fig. 3, Plate IV). The quartz crystals vary in size from 5 mm. in diameter to 0.2 mm. and are not numerous. The largest orthoclase crystals are 2 mm. by 1.4 mm. and they are also not so plentiful as the striated feldspars. A large phenocryst of zonally built plagioclase is 5 mm. by 2 mm. and there are a good many plagioclase crystals which, as a rule, are less than half this size. There is some chlorite and iron oxide representing what appear to have been phenocrysts of biotite. These are not numerous.

The phenocrysts occupy about 70 per cent. and the groundmass 30 per cent. of this rock. Of this 70 per cent., the ferro-magnesian minerals probably compose 3 per cent., the quartz 12 per cent., the orthoclase 20 per cent., and the plagioclase 35 per cent. This composition indicates that the rock approaches a dacite, but the groundmass contains so much orthoclase that it may still be regarded as a rhyolite-porphyry. The groundmass is holo-crystalline, re-crystallized, coarser than that of the rhyolites and composed of quartz and orthoclase, the latter considerably altered to sericite. In the large zonally-built feldspar mentioned above, the index of refraction is greatest in the centre and grades towards the borders. Some of the zones have given rise to white mica by weathering. The facts that the larger phenocrysts have their inner zones of the more sodic feldspar than the outer, and that the groundmass contains so much orthoclase shows that the more basic feldspars were the first to crystallize.

A thin section (32) from a dike of porphyry about two feet wide and cutting the greenstones between the iron ranges, shows that rock to be a feldspar-porphyry. Its composition would be about that of a trachyte-porphyry, but its structure would not justify the application of the term trachyte. There are no quartz phenocrysts, and the groundmass does not contain a great amount of quartz. The phenocrysts are not rounded, and are composed of Carlsbad twins of orthoclase, crystals of plagioclase, some of which are zonally built and composed of albite and anorthite, and one crystal of a

composition between that of labradorite and andesine. Some interesting biotite crystals occur. They are deep brown, colorless, or greenish, the latter color being found where they are considerably altered to chlorite. The shape of the plates is rudely triangular, and they are spotted with little holes around which radiating aggregates of very fine rutile needles have developed as a secondary product. Little crystals of iron oxide are also a product of weathering action and they occur around the border, scattered throughout the crystals, or grouped in little bunches. In the cases where this mineral has lost its color by bleaching, its pleochroism has largely disappeared; otherwise it is typical for biotite.

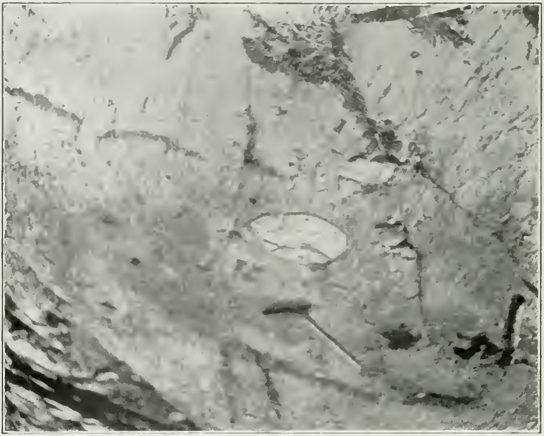


Fig. 13.—Tuff and agglomerate, Johnson creek. (Compare Bayley, Mon. XXVIII., U.S. Geol. Surv., p. 161).

**Rhyolite-Tuffs, Agglomerates and Conglomerates**

The terms rhyolite-tuff, agglomerate and conglomerate can be properly applied to one rock formation occurring in the Onaman district, because these different types of rock grade into one another, so that no sharp line can be drawn between them. There seem to be all gradations from a pyroclastic rock composed of fine materials or cemented by them, through a sediment composed of coarse and fine volcanic fragments to a fragmental, volcanic rock with some of the fragments sufficiently waterworn to be called a conglomerate. The predominant part of the formation is composed of coarse and angular volcanic fragments with a matrix which shows that much of the rock was deposited in water and is therefore a true agglomerate.

Portions of these rocks correspond very closely to the agglomerates which Lawson has described from the Lake of the Woods region[16] and the descriptions given by Bayley

[16] Can. Geol. Sur., Vol. I. (1885), pp. 49-54 c.c.

for the Kitchi Schists of the Marquette region of Michigan[17] would also be quite appropriate for portions of this series. Both of these series should be classed as Keewatin tuffs according to the scheme of the International Committee on Nomenclature.

Fig. 14.—Pebbles from the conglomeratic tuff on the Miller claims. (Compare Bayley, Mon. XXVIII., Pl. V., U.S. Geol., Surv.).

At the close of my first period in the field, a portion of these rocks was doubtfully regarded as Huronian and was so laid down on the map accompanying my first report on this area[18]. This article has already been referred to in the Introduction to this

[17] The Marquette Iron-bearing District of Michigan, U. S. Geol. Surv., Mon. XXVIII., pp. 159-162.

[18] 17th Rep. Bureau of Mines, 1908, p. 183.

paper. The true composition and stratigraphic relations were, however, seen later when larger areas of the rocks were located.

*Distribution*:—These rocks only occur in rather small outcrops, but they are scattered pretty well over the two synclines in which the Iron formation occurs. They begin at the twelfth portage on the Red Paint river below Holliday lake and extend for over a mile along the south side of the river to near the Maple Leaf claims, where they are replaced by the rhyolite and Iron formation. A small outcrop of rock along the north side of the Iron formation on the Height of Land claims, resembles the tuff, and on the southeast side of the greenstone mass which is faulted into the Iron formation on the Winter Camp claims, a small patch of tuff occurs. About half way between the Winter Camp and Miller claims an outcrop projects through the drift along the north side of the syncline, and some of the fragments strongly resemble pebbles in a true conglomerate, while others are very angular. (Fig. 13.) On the Miller claims a small outcrop appears where it has been folded into the Iron formation and another patch along the south side of the outcrop between the rhyolite and the Iron formation is very similar to a conglomerate. Another small outcrop occurs a short distance northeast from the latter and along the same syncline.

In the southern range these rocks occur along either side of the Iron formation for practically the whole length of the syncline, and a few outcrops were found farther south, but the greater portion of them are confined to the basin along which the Iron formation occurs.

*Stratigraphic Relations*:—In almost every case where these tuffs, agglomerates and conglomerates were found in contact with solid rock, the contacts were with rhyolite and Iron formation. In the small outcrop northeast of the Miller claims an outcrop of greenstone occurred beside the conglomerate and on the Winter Camp claims the tuff lay against the greenstone. In the southern range there are a few doubtful cases, as some of the schists which come in contact with the agglomerate are of uncertain origin. The fact that almost no greenstone fragments occur in the overlying conglomerate shows that it cannot be regarded as a basal conglomerate, such, for example, as that of the Lower Huronian.

The Iron formation overlies conformably this series of rocks and, in a few cases, there is a possibility of interbedding of the two. The relations are such that it is impossible to determine, in some cases, whether the presence of the tuff bands in the Iron formation is due to folding in, faulting in, or interbedding. If they are interbedded, we have a condition here similar to that described by Coleman and Willmott for the Michipicoten district.[19] The outcrops occurring in this way are always very limited in size, and the fragments are not large, so that they may have come from the surrounding lands where they had previously been deposited by volcanic explosions. They could have been transported by water as the fragments of feldspar in the graywackés have been carried. In one case a half dozen of these fragments were observed in a slate lying as narrow bands between thin seams of jasper near the apparent base of the Iron formation of the southern range, and these could not have been folded into the latter formation. They may have originated contemporaneously with the jasper and slate or have been washed in from surrounding lands.

*Thickness*:—This formation is nowhere very thick. In many places it is impossible to form any conception of what the thickness is, since folding has destroyed all signs of bedding, but where it occurs between the Iron formation and the rhyolite it varies from 1 foot to 50 feet in thickness. It appears to be thicker than that in some places, but the measurement cannot be given with certainty.

[19] 11th Rep. Bur. Min., Ont., 1902, p. 170.

**Petrography of the Tuffs, Agglomerates and Conglomerates**

*Megascopic Characters*:—Probably the most striking features in these rocks are the great variation in size of the fragments, the spherical and angular shape of fragments occurring side by side, and the presence of fragments which are almost entirely of one type of rock. There are small areas in which the pebbles are almost all somewhat rounded—some of them, indeed, quite spherical—and as the matrix consists of sedimentary material, this rounding must be due to water action in favorable places along a shore or in shallow spots in a lake. The scantiness of water action on the greater part of the fragments shows that this conglomerate cannot be regarded as marking a great time interval.

The size of the fragments varies from microscopic sizes to those over 3 feet in length. One fragment measured 3¼ feet in length and 1½ feet in width, and another 2

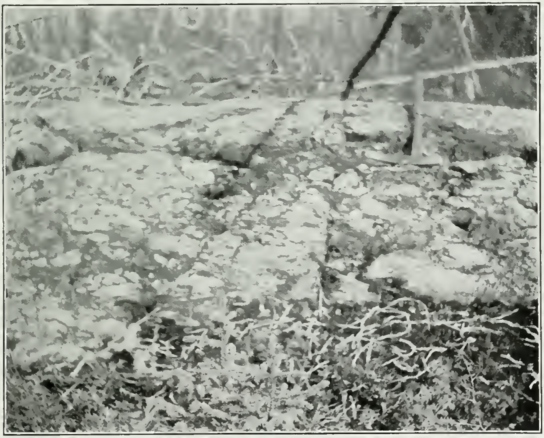


Fig. 15.—Tuff and agglomerate from the north side of the Iron formation on the southern range.

feet by 1¼ feet. A common size is 8 inches long by 3 inches wide, while along the southern iron range the fragments, as a rule, are much smaller, a great many of them being an inch long and a half inch wide (Fig. 15).

The color of the fragments is almost white on the weathered surface and this causes them to stand out above the matrix. They are often of a cherty appearance and harder than the matrix, so that this also causes them to be conspicuous.

The similarity in the composition of the fragments is a prominent feature. They are composed, almost without exception, of rhyolite with usually a very fine groundmass containing few phenocrysts of quartz and feldspar. In one case a small fragment of quartz similar to vein quartz formed a pebble in the conglomerate and in an outcrop of agglomerate one large fragment was identified as greenstone.

The matrix in places has the appearance of rhyolite, while in other cases a brownish mass is speckled with small quartz fragments and shows the characters of a sedi-

ment resembling arkose or graywacké. Portions of the matrix show no textural features, and appear as solidified material of very fine grain and of soft consistency.

*Microscopic Characters*:—Under the microscope the fragments in these rocks appear to be composed of rocks similar to the fine-grained types of acid rocks previously described. They are often very badly weathered and sometimes too fine-grained for their texture to be determined, but a great many of them are recognized as rhyolite-tuffs.

The matrix has various compositions, even within small areas. It varies from rhyolite to rocks with a composition similar to that of graywacké or arkose. Where rhyolite is the matrix it appears that this rock originally formed the cement for the fragments, while it was in the molten condition, and that flows accompanied the pyroclastic rocks. In the agglomerate at the twelfth portage on the Red Paint river, just below Holliday lake, one can find as cement between the fragments, rhyolite, carbonate and sericite, weathered chloritic and micaceous material like ash, and a rock corresponding in composition to arkose, all within a square mile.

The arkose-like type of matrix is seen in slide 161 and consists of numerous sharply angular to round quartz fragments, with a maximum size of 0.9 mm. by 0.2 mm. There are quartz grains scattered through a mixture of feldspar, carbonate, fragments of the groundmass of rhyolite, and sericitized material. The feldspar fragments consist of orthoclase and plagioclase. They are angular, and, as a rule, a little smaller than the quartz grains. The quartz and feldspar grains are in the proportion of about 3 to 1 in this slide, but in all others examined the feldspar is greatly predominant. The quartz contains mineral inclusions, but no liquid or gas inclusions were seen.

In the rock which is most conglomeratic in appearance, as, for example, the outcrops in the vicinity of the Miller claims, the matrix is composed of fragments of quartz, sometimes angular, but often subangular, and occasionally rounded. These are surrounded by sericite and fine-grained quartz. There is considerable calcite and pyrite, the former scattered irregularly through the section and the latter in small, anhedral masses, often partially or entirely altered to iron oxide. There are few fragments of feldspar. Zoisite crystals are present in one slide. Under the action of pressure the quartz grains have been granulated and partly re-crystallized into interlocking granules. In a few places a fabric resembling that of vein quartz or crystallized chert has been produced by this granulation and recrystallization. In one section (21) a few grains and parts of crystals of brown tourmaline are found. The association of this mineral with pyrite has already been discussed under tourmaline in the section on Contact Metamorphism. It might be repeated, however, that the tourmaline crystals have been fractured and the cracks, in some cases, filled with pyrite, which seems to be always associated with the tourmaline. It is probable that the cracks or pores which permitted the permeation of the boron gases forming the tourmaline, later permitted the infiltration of pyrite. It does not seem probable that this tourmaline is clastic in origin, but from a consideration of all its relations it must be regarded as due to fumarole action of the acid magma.

The matrix above described cements small angular to subangular fragments of rhyolite consisting of a fine-grained re-crystallized groundmass with an occasional weathered orthoclase phenocryst. Slim, needle-like feldspars occur in one of these fragments in a way characteristic of weathered igneous rocks.

Along the southern iron range the matrix of the agglomerate and tuff is made up essentially of broken fragments of feldspar, orthoclase and plagioclase, chiefly the former, with a lesser amount of quartz. The quartz grains have been granulated by pressure and partly re-crystallized. Considerable biotite and sericite are developed between the fragments and along the lines of cleavage. The mica has been bent around the feldspar and quartz fragments during the development of schistosity in such a way

as to produce a resemblance to flow structure. There is little evidence of orientation of the fragments during the formation of cleavage, since they are all so nearly equidimensional. The pyroclastic fragments consist of a fine-grained groundmass, crystallized so that the granules of quartz and feldspar composing it are drawn out into a fine net work of more or less parallel lines. In this groundmass there are a few scattered phenocrysts of orthoclase.

In other parts of this range, the composition of the matrix of the agglomerate and tuff approaches that of a graywacké, and it is hard to distinguish the two rocks, in some cases, except by the presence of the coarser fragments. The graywackés are, as a rule, more extensively weathered.

### The Iron Formation

*Distribution*:—The Iron formation of the Onaman district occurs as outcrops arranged in two bands, so-called ranges, extending nearly east and west across the district and about 2 miles apart. For convenience in description, these ranges have been distinguished as the northern and southern ranges, the latter name replacing the local term Bain claims, used for the southern band in my previous report. The northern range, beginning below Holliday lake, extends across the Height of Land and along Johnson creek nearly to the border of the district, a distance of almost 10 miles. It is not represented by a continuous outcrop, the gaps being of considerable extent. The outcrops are, however, sufficiently close together and the local magnetic influences, where outcrops do not occur on account of the thick coating of drift, are sufficiently strong to warrant one in regarding this as a continuous band lying along a syncline. The strike of the outcrops is, in general, east and west, but it varies from 70° to 120°, because of irregularities in the syncline due to faulting and the presence of igneous rocks. The latter have resisted the folding stresses better than the sediments, and have not conformed to the regular troughs which tend to develop in the sedimentary rocks.

The width of the range varies greatly. At the western end the range is represented by a few feet of very lean Iron formation, but near the Maple Leaf claims it widens to nearly half a mile. At this point the area is not, however, occupied by continuous Iron formation, but only by narrow outcrops appearing in green schist, tuff, or rhyolite. Where the range crosses the Height of Land the formation is continuous over a width of 150 yards, but contains a good deal of graywacké and slate, and some rhyolite and green schist have been folded into it.

The outcrop at the divide disappears under the drift and re-appears again on the Winter Camp claims, 2 miles to the east, where the formation occurs as narrow outcrops on either side of a mass of greenstone which has been faulted into it. The formation is again hidden under the drift and three miles to the east re-appears as a considerable outcrop in the vicinity of the Miller claims. Although the range here is broken up by the older rocks near the surface and the formation is excluded from view by the drift which covers portions of this area to a depth of 100 feet or more, sufficient outcrops occur to show that the range can be traced over an area 2 miles long by 1½ miles wide. The formation here is, on the whole, pretty lean, there being much slate and schist with the jasper.

The southern range is somewhat more continuous and compact than the northern. The most westerly outcrop lies along the south side of Castor lake, where a very narrow band of jasper occurs. There is then a break where drift extends for a mile between this small outcrop and the main portion of the range. It is quite probable that the formation underlies the drift. The main portion of the range is represented by almost continuous outcrops for a distance of two miles, with a maximum width of 700 feet. This range, like the northern one, also contains a good deal of foreign rock in its widest areas.

At the east end of the southern range the Iron formation runs under drift, but local deflections of the compass in a large swamp and the occurrence of a very small outcrop of Iron formation a mile and a quarter east of the main range, show that the range is continuous for at least a mile and a half under the swamp. East of this little outcrop large hills of moraine, composed of sand and gravel, extend eastward as far as the eye can reach.

Outside of the outcrops already mentioned there are two very small patches of the formation occurring to the southeast of the main range, near a large diabase dike. There did not seem to be any evidence that these were related to the dike, but they were found as little ledges of jasper contained in slate and green schist. The Iron formation must have extended over much larger areas than the outcrops now indicate, and now only remains in synclines developed along the original basins which have initiated the downward movement during the folding.

*Thickness, strike and dip*:—On account of the complexity of the folding in this area, it is impossible to work out the thickness of the Iron formation even approximately. Bands of jasper appear, disappear and re-appear again, and cannot be correlated with any degree of certainty in different portions of the range.

The strike of the ranges is approximately east and west, but locally that of the outcrops of the Iron formation varies considerably. On the Height of Land claims, the strike of the outcrop changes from 80° at the western end to 70° at the east, and on the Winter Camp claims, two faults are responsible for a strike of 70° in the Iron formation. In the vicinity of the Miller claims the strike varies from 90° to 120°, the latter being in a narrow band extending southeast from the main range. The presence of large masses of igneous rock seem to be responsible for the differences in strike here.

In the southern range the general strike is 95°, with local variations as in the small outcrop south of Castor lake.

The dip in the northern range is close to 90°, but towards the eastern end it varies from 55° north to 75° north; in other words, the folds seem to be overturned to the extent of 15° to 35°. (See structure section on accompanying map.)

In the southern range the dip varies from 55° northward to 90°, with 70° north as a common occurrence. This dip is also that of the planes of schistosity in the rhyolite along the southern edge of the Iron formation, and although it represents a considerable overturning of the folds, I think this is only local and due to the presence of igneous rocks. The latter became mashed into schists and did not respond to the folding stresses in the same way as the sediments.

In other Keewatin areas the dip of the Iron formation is, as a rule, more steep than that mentioned above; on the whole, closely pressed together, nearly vertical, folds, with a commonly occurring dip of 70° north, are the results of the great folding which included all of the Keewatin rocks.

*Stratigraphic and structural relations*:—The Iron formation lies conformably everywhere upon the pyroclastic and sedimentary series previously described. Where these rocks are absent, it may come in contact with rhyolite or green schist, but it has not been observed in contact with typical greenstone, except where the two formations were brought together by faulting. The jasper is separated from the green schist and, as a rule, from the rhyolite, by a slate, usually a phyllite. There seems to be good evidence, as already pointed out in the consideration of the acid eruptives, that the Iron formation has been intruded and to some extent overflowed by the rhyolite-porphyry and rhyolite mass lying across the east end of the northern range. Outside of this one case, there is no definite evidence to show that these rocks have intruded this formation, and there is a good deal of evidence to show that most of them are older than the Iron formation. They are folded into it in several places, and, as already mentioned, the presence of a zone of sediments around the outcrop dis-

tinguishes these masses from those which were intruded. The pyroclastics are frequently found folded and sometimes faulted into the Iron formation and, in some cases, outcrops appear to indicate that some of these are interbedded with the Iron formation. It is difficult to explain some of the narrower bands on any other assumption than interbedding, and if they are interbedded it is impossible to determine whether they were deposited by volcanic eruptions occurring during the deposition of the Iron formation, or whether they were brought in from higher lands by water. As these doubtful bands consist of tuffs, and the fragments are not large, it is possible that they may have been deposited by earlier eruptions on the neighboring lands and transported by water action, as the coarser portions of the graywackés have been carried. In the Michipicoten area Coleman and Willmott considered that volcanic eruptions were contemporaneous with the deposition of the Iron formation, and that the Wawa tuffs were interbedded with the slates and jaspers. It is possible that a similar condition existed in the Onaman district, but there is no definite evidence regarding the matter.

Careful microscopic investigation has failed to reveal any rhyolites interbedded with the Iron formation, but, as previously stated, these might exist and be overlooked, as some of the weathered igneous rocks might very readily be mistaken in the field for weathered sediments.

The Iron formation is not cut by the Laurentian granite on the accompanying map sheet, but on the "Red" portage on the Red Paint river the granite and granitoid gneiss cuts Iron formation of the same age as that on the map. The hornblende-porphyry cuts this formation as a small irregular mass on the southern range, and two diorite dikes cut across it on the Height of Land claims. The Keweenawan diabase dikes cut this same formation in many places, especially on the southern range, and they represent the latest consolidated rocks in this area.

#### Petrography of the Iron Formation

There are several distinct rocks included in the Iron formation, but they are so related that they must be treated as a unit. These rocks are ferruginous cherts, slates, phyllites, graywackés, actinolite-magnetite-schists, dumortierite-magnetite slates and jaspers, garnetiferous and tourmaline slates. The last four of these types have been treated pretty fully in the sections on Dynamo-Regional and Contact Metamorphism and will not be discussed in detail here.

The relations between the rocks of this formation are such that a band of jasper half an inch in width may occur between bands of slate and graywacké 20 feet in width, and, on the other hand, almost clear jasper bands may reach a maximum of nearly 50 feet. Some of the narrow bands of ferruginous cherts may contain a large percentage of iron, as, for example, one band a few inches wide from the southern range, which was analysed and found to contain 50 per cent. of metallic iron and 23 per cent. of silica.

The banding in the jaspilites, which consist of banded jasper, red or black, alternating with bands of cherty quartz, is often distinctly marked, but the bands are not so clear cut as in the Iron formations of some other regions. Fig. 16 is an example of banded jasper and slate from the Lake Wendigokan district east of lake Nipigon and it is particularly adapted for illustration, because the white slate bands stand out in strong contrast to the red jasper. The slate weathers on the surface to a white shade which is a color characteristic of many of these slates. Another example of remarkable banding is seen in Fig. 1, Plate IV, in which there is represented a magnetite and siderite chert, from the Iron formation on Little Long lake, about 50 miles east of Lake Nipigon. This specimen was obtained through the kindness of Dr. A. P. Coleman, by whom it was collected.

Although many of these bands are clear cut in the hand specimen, they grade more or less into one another in the microscopic section. In many cases there is a gradual transition between cherty magnetite bands, red jasper bands and slate bands, these transitions indicating a gradual change from predominant clastic and minor chemical sedimentation to predominant chemical and minor mechanical deposition.

### The Slates

*Megascopic Characters*:—The slates in some cases possess almost perfect cleavage, and the parting varies from this to an irregular and sub-conchoidal fracture. They are banded with coarser and finer layers, varying in thickness from ¾-inch to a millimetre. In some cases the coarser layers may be classed as graywackés. Their color

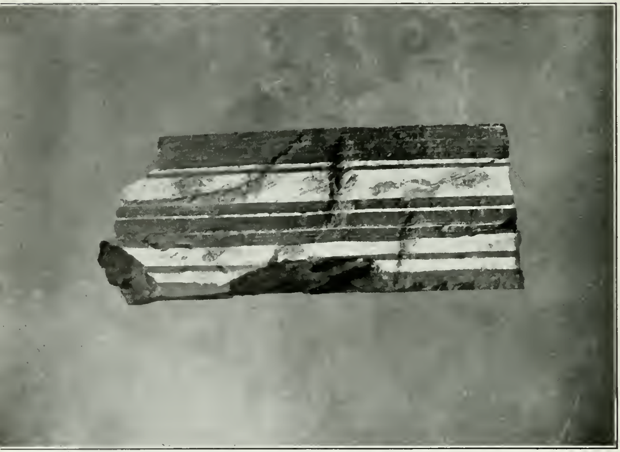


Fig. 16.—Banded jasper and slate from the Lake Wendigokan district.

varies from white to black on the weathered surface, with usually a dark gray to black interior. In some cases the color is greenish from the presence of chlorite along the cleavage planes. Very small veins of silica frequently cut across the rock in all directions and fill small fractures.

*Microscopic Characters*:—The chief minerals of these rocks are quartz, in clastic fragments, and in the form of crystallized chert, green and brown biotite, sometimes bleached almost colorless, sericite, magnetite, hematite, pyrite, dumortierite, kaolin, small bits of feldspar, iron carbonate, calcite, epidote and sometimes tourmaline and garnet. The biotite often reaches such proportions that the slate should be regarded as a phyllite. The magnetite or hematite may form nearly half the rock, and often the carbonates reach such proportions that the rock may be called a carbonate slate. The tourmaline is rather widely distributed in these rocks, and it occurs as very small cry-

stals lying in all directions, and in such a way that it appears as an undoubted secondary development, and not as a clastic mineral. It is more common in the slates of the northern than in those of the southern range, and it occurs most plentifully near the eastern end of the former range.

Slide 126 is from a phyllite on the Miller claims. It consists more than half of brown biotite in small flakes with their long axes nearly parallel to the cleavage lines, and with a poorly developed false cleavage cutting the true cleavage plane.

Slide 113, from an outcrop of garnetiferous slate southeast of the Miller claims, contains quartz fragments, many of which have suffered re-crystallization around the borders. Sericite, chlorite, kaolin and iron oxide are widely distributed in the section and disseminated pyrite occurs usually in small specks. Small, pink garnets, in euhedral crystals, are associated with a considerable amount of tourmaline in very small crystals. The tourmalines in long slender prisms have been broken by dynamic action. The color of this mineral varies from nearly colorless to brown, and the pleochroism varies with the color. Epidote and zoisite occur in very small crystals and one aggregate of actinolite needles was seen. Although there is not the intimate intergrowth of the individual minerals generally characteristic of contact rocks, this slate, on account of its mineral associations, strongly suggests a contact metamorphic rock. It occurred on the border of a large swamp without any igneous rock supposed to be later, within a quarter of a mile. About a quarter of a mile away, a low outcrop of rhyolite-porphyry occurs, and some related mass may have been responsible for the development of this group of minerals in the slate.

Slide 173, from the slates of the Iron formation on the southern range, is interesting in showing the transition of a slate into a graywacké. There is a good deal of magnetite showing in the section, and it is much more plentiful in the fine slaty layers than in the graywacké bands. There are two things that this difference in the magnetite content of the slate and graywacké might indicate. One of these is that while clastic and chemical sediments were being deposited at the same time, in the case of the slaty material the deposition was so slow that a larger proportion of chemical sediment was laid down than in the case of the coarser clastic. The other condition is that the iron was deposited in the coarser rock and later removed by waters which could more readily circulate in it than in the slate. This section also contains a little tourmaline in very small broken prisms, and one little garnet was seen.

### The Graywackes

*Megascopic Characters*:—The graywackés are monotonous in character, as the rocks are all of dark gray to brown color, and contain small fragments of quartz and feldspar visible to the naked eye. Sometimes a little pyrite is disseminated through the rock Fractures intersecting at right angles cut these rocks into more or less square blocks, and parting along the bedding planes is frequent. The fracture in some cases is subconchoidal.

*Microscopic Characters*:—The microscope shows that these rocks are composed of varying amounts of feldspar and quartz. In some cases the quartz fragments form 40 per cent. of the fragments found in the rock, but generally a smaller percentage is present, and the following description is taken as an average example for the district: In the average slide the proportions of the quartz and different types of feldspar were found to be, quartz 25 per cent., plagioclase 10 per cent., and orthoclase 65 per cent. Some of the plagioclase was identified as albite. The relation between the fragments and matrix vary from 25 per cent. matrix and 75 per cent. fragments, to 60 per cent. matrix and 40 per cent. fragments. The fragments are very often little rounded, but, as a rule, much weathered. They generally show more weathering action than the feldspar fragments in the matrix of the agglomerates.

The matrix is composed of sericite, biotite, chlorite, very small fragments of quartz, weathered feldspar, kaolin, and iron oxide. In some places considerable zoisite and epidote occur. Calcite, pyrite, and little crystals of apatite are widely scattered through these rocks. In the development of schistosity, the minerals of the matrix have been crowded and bent around the fragments.

In the study of these graywackés, one is struck by the similarity between them and the cementing material binding the fragments in the tuffs and agglomerates. In fact, it is almost impossible to distinguish the pyroclastics, where the larger fragments are not present, from the graywackés. There is probably no way of separating them but by chemical analysis, and it is doubtful whether this would always distinguish them. Should these graywackés ever be shown to be of pyroclastic origin, it is probable that the slate would prove to be of similar origin, as they grade into one another. In that case the slates would represent the finer tufaceous material of the pyroclastic series.

Fig. 17.—Outcrop of Iron formation rising above the swamp on the southern range.

### The Ferruginous Cherts

The ferruginous cherts include the red banded jaspers and silica, or jaspilites of Van Hise, the cherty magnetites and cherty iron carbonates. These three types are all closely related, as they grade into one another, and the latter type is probably the original rock from which the greater part of the other two is derived.

*Megascopic Characters*:—The jaspilites are crypto-crystalline rocks, with bright red bands of jasper interbanded with and grading into almost pure cherty bands. These bands vary in width from half an inch to almost microscopic sizes. There are frequently bands with fairly coarse silica formed by some of these bands becoming coarsely crystallized, and the glistening surfaces of specular hematite and silica are prominent.

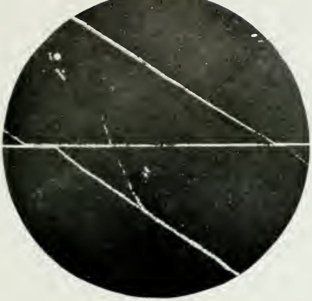


Fig. 1

Fig. 1.—Photomicrograph of thin section 63, showing fracture cleavage in a hematite slate. Elongation has been produced by slipping. The direction of the pressures producing the fracturing and shearing intersects the obtuse angle at which the sets of parallel fractures intersect one another. Natural size X 35.

Fig. 2.—Photomicrograph of thin section 60, showing magnetite crystals in a jasper. The white groundmass is chert and the zones around the magnetite crystals are cherty quartz. This figure illustrates the alteration of siderite to magnetite with a reduction in volume of the iron compound. The rhombs of siderite are replaced by crystals of magnetite, surrounded by a zone of silica. Different stages in the process of alteration may be seen. Natural size X 35.

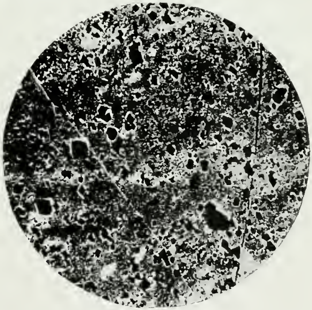


Fig 2.


Fig. 3.

Fig. 3.—Photomicrograph of thin section 60. Similar to Fig. 2. Natural size X 225.

Plate II.

Magnetite may, in some cases, form the principal part of some of the bands, especially where the rock has been subject to great metamorphism. Where the rock is mostly altered to magnetite it is, as a rule, more coarsely crystalline, and the banded structure is not so distinct. Sometimes ribands of slate occur between the bands of jasper and form a very regularly banded rock (Fig. 16).

There are no distinctly banded cherty carbonates in this area,—in fact the carbonates are rather rare here, as the metamorphism has been so intense that they have passed over into the oxides.

The great number of little quartz veins filling fractures all through the jaspers is very characteristic (Fig. 3, Plate I). The fracture is conchoidal to irregular. Some of the hand specimens retain a splendid polish made by the glacier, and others taken along fault planes still have good slickensides.

*Microscopic Characters*:—Under the microscope the banding of the jaspilites is not so clear cut as in the hand specimen, because in detail these bands usually grade into one another although, in a few cases, a distinct boundary line may be seen. The thin sections are monotonous, in that they present so little variation in mineral content. They are made up of a groundmass of silica crystallized to a greater or lesser degree, with the individual granules of quartz interlocked with one another. The granules usually have irregular outlines unless the crystallization has occurred under the influence of contact metamorphism, when the outlines are, as a rule, clear cut. The more coarsely crystalline silica is found in the bands which are not full of iron oxide, as the iron seems to interfere with the perfect crystallization of the silica, and the fine grained jaspers appear to owe their present condition to the finely disseminated hematite which has prevented the segregation of the silica and its crystallization into coarse granules.

The hematite occurs in little crystals and in specks of sub-microscopic size scattered throughout a silica groundmass. Sometimes these crystals are six-sided but, as a rule, they are somewhat irregular in form. Associated with the hematite are crystals of magnetite, usually euhedral in outline, and varying from almost sub-microscopic size to one-tenth of a millimetre in diameter. These crystals occur scattered all through the fine grained red jasper, or segregated along definite bands.

That much of the magnetite in these rocks is developed directly from siderite is evident from the occurrence of octahedra and other crystal forms of magnetite in rhombic spaces formerly filled with iron carbonate. All stages have been observed in the substitution, from the complete siderite rhombs to the rhombic moulds with a magnetite octahedron surrounded by a zone of cherty silica (Figs. 2 and 3, Plate II). This silica fills the space caused by the reduction in volume of the iron compound, when decarbonation and oxidation occurred with the loss of carbon dioxide. The examples also illustrate the great transfer of silica in these rocks. Siderite is widely distributed through all of the Iron formation rocks, and its alterations can be traced in such a way as to show that it has given rise to the greater quantity of the Iron oxides. Distinct rhombs of siderite, replaced by chlorite, have been found in a slide (No. 56) from the Poplar Lodge region. Calcite is also common, but its relations to fractures makes it appear that this mineral is generally a secondary mineral derived from outside sources, though in some cases it appears to be an original constituent of the rock. Sericite and chlorite very frequently occur dispersed throughout the jaspers, and as the latter approach a slate by an increase in mechanical sediments, green biotite sometimes becomes common. In slide 47, from the southern iron range, there is considerable biotite, parts of it bleached almost colorless. The typical brown pleochroic biotite grades gradually into almost colorless mica. This alteration seems to be due to a weathering process.

Careful observations were made with the view of ascertaining whether clastic quartz occurred in the jaspers. In several cases there were found what appeared to

be clastic fragments, but it is difficult to prove they are such, because during the metamorphic processes the fragments have become partly rounded off and recrystallized. That it is impossible to distinguish a fragment of quartz which has been granulated and partially or entirely recrystallized under dynamo-regional influences, from some granules of crystallized chert, is evident from observations of changes in the quartz fragments in graywackés and the phenocrysts in porphyries. In slates which grade into jaspers one can find a few clastic quartz fragments, and there is no reason why they should not occur in some of the jaspers, but one has no hesitation in saying that clastic quartz is not the source of the great mass of the cherty silica in the Iron formation.

A characteristic feature of the jaspilites is the fine veins of quartz filling openings caused by the development of fracture cleavage. This quartz can be traced to the groundmass of these rocks, and its transfer clearly demonstrates the point which Prof. Leith makes, viz., that in the processes of metamorphism and concentration in the minerals of the Iron formation, the silica is more readily transferred than most of the others. Besides the silica some sericite, calcite, siderite, magnetite, hematite and chlorite are found in these veins, but only sericite, calcite and chlorite are very common. Even these are not so abundant as the quartz in the veins which traverse the jaspers. The magnetite and hematite in these veins are probably due to the alteration of siderite which has been carried in solution.

#### Genesis of the Iron Formation

There is a great deal of similarity in the Iron formation of all the Keewatin regions, and so much has been written on the subject of the origin of the rocks of this formation, that little can be added to the theories already proposed. In the case under discussion there remains only the application of the observations made in the field to a part or all of these theories. In the Survey reports of Minnesota, the Messrs. Winchell have put forth the theory that these iron-bearing deposits are chemical precipitates from a heated sea existing under conditions postulated by the Nebular hypothesis for the early condition of the earth.[20]

At the present time there is a tendency for geologists to depart from the idea of the existence of these special conditions, and to suppose that in Keewatin time conditions were much more as they have been in later time. With this change of view, the time for the first existence of life on the earth has been pushed back to an earlier date. The leaders among the geologists who have been instrumental in bringing about this change of view are Chamberlin and Salisbury.

What might be considered a modified view of the older theories of the origin of the Iron formation is put forth by Leith in an article on the Iron Ores of Canada[21] in which he expresses the opinion that the pre-Cambrian iron deposits owe their origin, in part at least, to hot igneous rocks contributing iron salts directly to the sea by magmatic waters. Dr. Leith bases his assumptions on the close association of the iron ores with basic extrusive rocks, present in all the systems of rock in which large deposits of banded jasper occur. He further points out that the banded structure of these deposits is unlike any sedimentary rock forming at the present day, and that this structure can be produced by experiment in the laboratory.

From an extensive study of the iron deposits in Lake Superior region, Irving, Van Hise, Leith, Bayley, Spurr, Coleman, Willmott, and others have shown that there are two chief sources for the iron oxides, these being the cherty iron carbonate and the greenalite. The latter mineral was regarded as glauconite by Spurr, but from a careful study of it, Leith has shown that it is not glauconite, but a hydrous silicate of iron without potash.[22]

[20] N. H. and H. V. Winchell, Geol. and Nat. Hist. Surv. of Minnesota, Final Rept., Vol. IV. (1899), p. 547; ditto Bull. No. 6 (1891), pp. 105, 111.

[21] Economic Geol., Vol. III., No. 4, June-July, 1908.

[22] U. S. Geol. Surv., Mon. XLIII.

In the older reports the writers seemed to regard the supply of the silica as the most difficult problem to solve in connection with these banded deposits. Dr. Leith now considers that the silica is more largely transported than the iron compounds during the concentration of the iron ores. Julien has also pointed out that silica is very largely transported during weathering processes.[23] T. Sterry Hunt has found as much as 21 per cent. of soluble silica in the bog ores of Quebec,[24] and in analyses the writer had made from bog ore in the vicinity of the English river of Ontario, over 8 per cent. of soluble silica was found. Clarke has shown that a large percentage of silica exists in two types of waters, those containing much organic matter and those flowing from crystalline rocks.[25] The soluble silica mentioned above is that which has been precipitated from organic compounds, and Van Hise[26] states that much of the silica in the Iron formation is soluble, so there is some similarity between these two types of silica deposits.

It is well known that chert deposits are the product of organic remains and jaspers are known which contain shells of radiolarians.[27] Other agencies for the transport and deposition of silica are hot and alkaline waters.

From the above observations it is clear that several agencies are adequate to supply silica for the iron deposits. The chief among these agencies are life, and hot, or alkaline waters.

For the solution and transportation of the iron of these deposits from the rocks surrounding the basins in which they were formed, a high content of carbon dioxide in the atmosphere and the action of organic acids have been suggested. From the investigations of the bog ores of Sweden and Quebec, and of the solution and transport of iron in other places, the action of organic acids seems to be the predominant agency at work. T. Sterry Hunt, in the analysis already quoted, found over 15 per cent. of organic acids in the bog ore of Quebec, and Julien has given a great many examples of other analyses which go to show that plants play a very large part in the solution and transportation of iron. In analyses of water from the bog ore district near English river, the writer found that as much as one-eighth of a pound of iron was carried by a ton of water. This was in a region where one would not judge that any great amount of iron could be obtained, because the underlying rocks are Laurentian gneiss, and the drift is very largely composed of boulders and pebbles of granite and sand which have few constituents other than quartz and feldspar. As pointed out in an article on that region, appearing in the present report of The Bureau of Mines, the writer has endeavored to show that the physiographic conditions of the area practically control the solution, transportation and deposition of bog iron. If the land has low relief, so that the streams are sluggish and abundant vegetation exists, organic acids are capable of dissolving large quantities of iron salts. As pointed out earlier in this paper, the physiographic conditions existing in Keewatin time seem to have been very favorable for the development of enclosed basins and unfavorable for well developed drainage. Average basic rock contains about 9 per cent. of iron, and in the presence of plants, volcanic rock such as that so common in Keewatin time, will disintegrate very rapidly. It has been shown that in a few years the lavas of Mount Etna have been brought into a condition suitable for vineyards through the organic action of the prickly pear. Some will argue that the weathering of the rocks is not sufficient to supply the great thicknesses of chemical sediments found in these iron deposits, but Prof. Chamberlin has pointed out that it is probable a selective process was carried on during the Keewatin, when the iron salts were leached out and the coarser clastics left on the land. In Huronian time, to which the great beds of clastics belong, the

[23] A. A. Julien's Monographic paper, Proc. Am. Assn. Adv. Sci., 1879, Vol. 28, p. 311.

[24] Geol. of Canada, 1863, p. 511-13.

[25] F. W. Clarke, U. S. Geol. Surv. Bull. 330, p. 84.

[26] 10th Ann. Rept. U. S. Geol. Surv., Pt. I., p. 399.

[27] Radiolarians in the Tithonian Jaspers. Eastman's Translation of Zittel, Vol. 1, p. 40.

drainage conditions had so improved that this coarser type of sediment could be carried. Unless it can be shown that the slates and graywackés in the Keewatin are composed of materials supplied directly to the sea by volcanic action, it must be admitted that sufficient basic rock was weathered to supply a very large amount of iron. If an abundance of plant life can properly be postulated for the Keewatin, it seems to me that the agencies at work upon the earth were adequate to supply the iron and silica for these iron deposits. It is true that the conditions existing in early Keewatin time appear, from the evidence of such enormous volcanic activity, to be very unfavorable to life, but the prolonged period of quiet sedimentation which must have occurred during the deposition of the Iron formation would give an opportunity for the development of living organisms. One would also expect thatt the intrusion of the Laurentian granite would greatly heat the underground water, and that up to the end of the Laurentian time the waters must have been very active chemical agents.

#### Origin of the Banding

The remarkable banding found in these old deposits is one of the most difficult features to explain. The only deposits forming at the present day which seem quite equivalent to them, are those found around hot springs. In such areas there are deposits which very strongly resemble the banded rocks of the Keewatin, but it is evident that the latter were not deposited by hot springs, because there is no evidence anywhere of the columns and masses which would be formed around the orifices of such springs. During last summer some banded jaspery chert was found filling spaces between fragments of brecciated granite along the contact between the Keweenawan and Laurentian in the Black Sturgeon Lake region, south of lake Nipigon. It could not be proved whether this was a deposit from ordinary cold solutions bearing organic salts, or whether it was related to the diabase sills which are everywhere found intruded between layers of red shale.

The banding in these old rocks has certainly been accentuated by the processes of metamorphism, as one can observe under the microscope how the segregation of quartz and iron oxide into certain bands has taken place. Where the iron is very thickly disseminated through the rock, the crystallization of the silica does not seem to be so coarse and complete as it is in bands where the iron is scarce. This coarser crystallization seems to make the banding more prominent than it otherwise would be. There are, however, clear cut bands of cherty iron carbonate which have every appearance of being original (Fig. 1, Plate IV), and Leith's theory, already mentioned, is the best yet put forth to satisfy the conditions necessary for the production of this banding. Further, the sudden alteration from clastic sediments to beds of well banded jasper, which are in some places as much as 50 feet thick and contain very little clastic material, show that some abrupt change must have taken place in the conditions of deposition, and it seems certain that the deposition must have been rapid or there would be more mechanical sediments in the jasper. The alteration in the coarseness of the mechanical sediments and in their rates of deposition seem to be best explained by changes in climatic conditions.

As to the igneous rocks supplying the iron directly to the sea, there does not seem to be much evidence of that in the Onaman region, unless the acid pyroclastics were the source of the iron. In no place were typical greenstones found in contact with the jaspers except near faults, as a band of slate separates the two rocks. No basic igneous rock was found interbanded with the Iron formation. The jasper in a few places comes in contact with rhyolite, but almost everywhere there is a layer of pyroclastics between the rhyolite and Iron formation, and as a rule slate lies between the jasper and these volcanic fragmental rocks. These pyroclastics seem to have been deposited in water, and there is no iron worth mentioning found in them. If the iron were the direct product of these rocks, one would expect that it would have been laid down as well during the deposition of the pyroclastics as later. There is the possibility, however, of deposi-

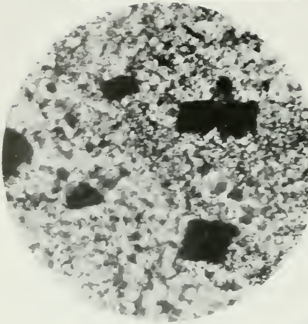


Fig. 1

Fig. 1.—Photomicrograph of thin section [illegible]. An actinolite-quartz-schist collected near an igneous intrusion. The chert of the iron formation has crystallized and the rhombs of ankerite have partly or completely altered to actinolite. Fine needles of actinolite may be seen all through the rhombs and radiating from their borders. Natural size X 35: crossed nicols.

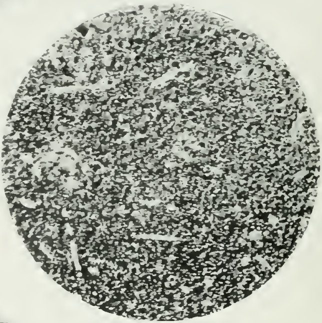


Fig. 2

Fig. 2.—Photomicrograph of thin section [illegible]. Dumortierite in jasper. The former appears as white crystals, though naturally they are blue. Natural size X 25. With polarizer.

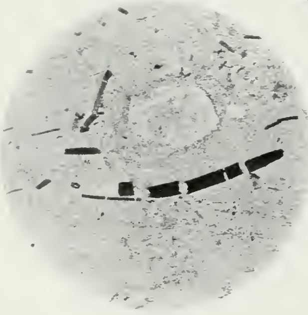


Fig. 3.

Fig. 3.—Photomicrograph of thin section 17, showing tourmaline in rhyolite. A phenocryst of orthoclase occurs near the center of the photo. The tourmaline shows the effects of shearing. Natural size X 35. With polarizer.



PLATE III.

tion having occurred and the iron having been later removed by leaching, because of the coarse texture of the rock. On the other hand, if the iron salts were supplied by weathering action, one would expect a period of time to elapse and a deposition of slate to occur before the waters of the lakes would be sufficiently saturated with iron salts to cause precipitation. If the mechanical sediments occurring in the Iron formation could be shown to be of pyroclastic origin,—and, as previously stated, some of them very strongly resemble fine pyroclastics,—it would then be unnecessary to restrict these deposits to enclosed basins, and the salts might have been supplied by rocks poured into the sea at a considerable distance from this area.

From a consideration of the different theories for the origin of these deposits, the writer concludes that the original rocks were cherty iron carbonate and oxide. No sign of greenalite has been found. The materials were supplied to enclosed basins by weathering action under the influence of plant life, and by heated igneous rocks coming in contact with the waters These rocks supplied salts of iron and the alkalies to the waters. That cherty iron carbonate was the original rock which gave rise to much of the magnetite and hematite is evident from the wide distribution of this mineral in all the Iron formation rocks, and by the transitions between it and magnetite which may be seen in the thin section. (Figs. 2 and 3, Plate II). That part of the hematite has been deposited as limonite, and dehydrated, is suggested by its very close resemblance to some of our bog deposits of the present day. Under the microscope one can see the gradations from a clastic slate with some iron oxide, into a mixture of hematite and minor amounts of mechanical sediment. The composition and texture of the rock are just what one would expect if some of our bog ores were highly metamorphosed. Since the deposition of these rocks they have been subject to extensive metamorphic changes which have developed magnetites and hematites from the carbonates, and crystallized silica from the chert. The banding has, in some cases, been emphasized, but in others, where concentration of the iron has been considerable, the banding has disappeared.

### Economic Possibilities of the Onaman District

The Iron formation of this district does not at present contain "pay" ore. There are many bands of jasper and magnetite which in themselves are rich enough in iron to make ore, but, as a rule, a great deal of schist and slate is mixed with them. There does not appear to have been much concentration, as neither the outcrops nor the drill holes which have been sunk show any bodies of rich ore. The rocks are, as a rule, so hard and close-grained that little percolation of water seems to have taken place. No drilling has been done, however, on the southern range, where the best outcrops of jasper occur.

A number of analyses of specimens collected from different parts of the area were made by Mr. N. L. Turner, the Provincial Assayer at Belleville, and a discussion on these follows.

Analysis No. 15. Dried at 100° C.

| | Per cent. |
|---|---|
| Total metallic iron | 50.32 |
| Iron in ferrous condition | 17.06 |
| Silica | 26.85 |

This analysis was made from a band of magnetite and chert a few inches wide and extending for several rods between bands of slate. A number of other bands such as this could be found in the southern range. It is difficult to trace the longitudinal extension of these bands as they run under the drift and often finger out, but some of them can be traced across good sized outcrops.

Analysis 16. Dried at 100° C.

| | Per cent. |
|---|---|
| Total metallic iron | 55.79 |
| Iron in ferrous condition | 10.94 |
| Silica | 37.10 |

This analysis was made from jasper collected from an outcrop about 15 feet across and rising out of the swamp. Near the eastern end of the main portion of the southern range (Fig. 18), on the south side of the outcrop, the rhyolite dips under the Iron formation at an angle of 60°, and a large vertical diabase dike cuts across the formation just east of this point, at an angle of 45°. This jasper band is probably more extensive beneath the swamp, and the converging of the rhyolite and diabase tends to form a triangular trough closed at the eastern end. Considering the grade of the ore in this outcrop and the possibility of a basin beneath it, one can regard its vicinity as one of the most favorable spots for drilling on the southern range.

Fig. 18.—Rhyolite dipping under an outcrop of Iron formation.

What appears to be a wider portion of the same band,—it could not be traced continuously on account of drift and irregular folding,—occurs about half a mile farther west, where it is over 50 feet wide and composed of jasper with very little slate interbanded. At this point the total metallic iron content would run from 30 to 40 per cent. At 35 yards west of this wide outcrop the band runs under swamp and cannot be definitely traced to the west, although a band about 100 feet wide, but containing a considerable amount of interbanded slate, occurs west of the swamp.

Analysis 17. Dried at 100° C.

| | Per cent. |
|---|---|
| Total metallic iron | 38.83 |
| Iron in ferrous condition | 12.9 |
| Silica | 50. |

This analysis was made from a band of distinctly banded red jasper and magnetite, and represents the iron content of a good deal of the well banded jaspilite, occurring in bands a few feet wide and lying between strips of slate.

From the analyses given above, it will be seen that the southern range does not contain ore which can be worked under present conditions, but it is evident that a considerable amount of low grade material might be obtained by sorting. There is a possibility that drilling might reveal ore in the spot mentioned above, but I should not expect to find any very large body of ore, because of the narrowness of the formation, the apparent shallow depth of the syncline, and the general lack of concentration of the iron in this area. This syncline appears shallow when compared with the great basins of the large workable iron deposits.

On the northern range diamond drilling has been done, by Mr. R. H. Flaherty, on two of the most favorable looking outcrops (Fig. 19). A hole running at an angle of

Fig. 19. Diamond drill at work on the Winter Camp claims.

60° from the horizontal and driven into the face of the hill was sunk 351 feet on the Winter Camp claims. It was drilled just north of a fault plane, where it was thought a concentration of ore might have occurred. Through the kindness of Mr. Flaherty, it was learned that nothing but jasper was found, and that it varied very little from that occurring at the surface.

Another hole was bored on the western member of the Miller claims, to a depth of 139 feet, at an angle of 52° S. It passed through 31 feet of jasper and then struck what was reported as greenstone, but which was probably rhyolite, in part at least, as this rock dips under the Iron formation near this point. The hole shows that the formation is thin at this spot. A specimen collected from this area as a type of some of the heavier jasper and magnetite samples, was found to be dumortierite-magnetite-slate and jasper, the analysis and complete description of which are given under the

section on Dynamo-Regional-Metamorphism. The analysis shows 42.8 per cent. of iron. There is a large amount of well banded jasper in this northern range, but little sign of concentration has been found. The iron content on the whole is low, but so much of the range is concealed from view by drift that one cannot say, until it is more fully prospected, just what some parts of it may produce. As in the southern range, the eastern end is better than the western, which gives no promise of producing ore.

### The Laurentian Granite and Gneiss

The Laurentian system is represented in this area by two outcrops, a small one barely rising above the swamp between the two iron ranges, and a large one along the southern border of the district. The latter extends an undetermined distance southward. The granite was not reached on the northern border, but reports from prospectors state that it occurs about seven miles north of Red Paint lake. This rock is widespread in the Red Paint River region, and along the river it is only broken by a few zones of Keewatin rocks. On the eighth portage on this river there is a large mass of attractive porphyritic granite in which the orthoclase crystals are an inch long.

In the district mapped, the granite has been almost entirely altered to gneiss, and it is similar to the great mass of Laurentian gneiss in the other portions of the Archean shield.

A thin section from the outcrop between the iron ranges showed the following characters: The rock is composed predominantly of microcline, with much smaller content of quartz. There is a small amount of green hornblende. The accessory minerals are biotite in very small quantity, magnetite, hematite and sphene. The biotite is partially altered to hematite, magnetite and chlorite. The apatite occurs as little inclusions in the feldspar. There are about forty small crystals of sphene, which occurs in acutely rhombic cross-sections or in prismatic forms with terminal faces. The largest prismatic form is 0.2 mm. by 0.05 mm in size. This rock is a hornblende gneiss.

### Huronian : Hornblende-porphyry

The hornblende-porphyry found here has been classified as Huronian, because a small mass of this rock was found cutting the Iron formation on the southern range and another outcrop is cut by Keweenawan diabase about two miles southeast. These conditions would thus place this rock between that of the Keewatin anad Keweenawan in age. Only these two small outcrops were observed.

The megascopic characters of this rock are: a peculiar pink weathered surface, with dark green blotches an inch long and oval to round in shape, scattered all over the surface; on the fresh surface the rock is seen to be holo-crystalline and finely granular, with a few phenocrysts of hornblende. A few specks of pyrite occur. Some of the feldspar weathers pink and the remainder of the rock is a very dark greenish gray color.

The microscopic characters are shown in thin section 198, in which the rock is composed of green hornblende and oligoclase feldspar. The hornblende is in euhedral and anhedral crystals of three magnitudes, and the fabric is seriate, *i.e.*, there is more or less gradual variation in the size of the crystals. The small hornblendes are, in some cases, completely surrounded by feldspar, and a poikilitic fabric is thus produced. Some of the former mineral is secondary and in places is almost colorless, a characteristic of the changes produced by weathering in these old rocks. This rock might be called a diorite-porphry.

### Diorite Dikes

On the Height of Land claims on the northern range, two dikes, 15 inches and 3 feet in width respectively, cut the Iron formation where a trench has been dug across the range. They could only be seen where the formation was stripped. The strike of

the smaller dike is 125°. and that of the larger one 110°, while the strike of the Iron formation is 80°. Their contact effects were seen in the formation of magnetite and granular quartz from the jasper lying close to them. The rock comprising them is badly weathered, and, in the hand specimen, was only identified as a basic rock from the presence of considerable dark mica and other ferro-magnesian minerals. Under the microscope the rock from one of these dikes was found to be so completely altered that no original minerals remained. There is a large number of secondary biotite flakes which are bent and broken, especially where warped around quartz granules. There are numerous patches of calcite, evidently developed from feldspar or hornblende, and associated with the calcite there is considerable free quartz. Much sericite is present in patches arranged as if it had been developed from orthoclase crystals.

Fig 20. Diorite dike cutting jasper on Height of Land claims on the northern iron range

A specimen from the larger dike was found to be sufficiently fresh to show that it was composed of albite crystals closely crowded, together with much secondary calcite and small flakes of biotite. A number of euhedral crystals of pyrite are scattered over the section.

The composition of these rocks corresponds to that of an altered diorite, and it is quite probable that they are of the same age and derived from a magma similar to that which gave rise to the hornblende-porphyry or diorite porphyry described above.

### Keweenawan Diabase

It has seemed wise to consider as Keweenawan a series of diabase dikes which cut all the consolidated rocks of the Onaman district. The diabase strongly resembles that of the Keweenawan in other districts, not far removed geographically from the Lake Nipigon basin, which was the scene of great volcanic activity in this period. A

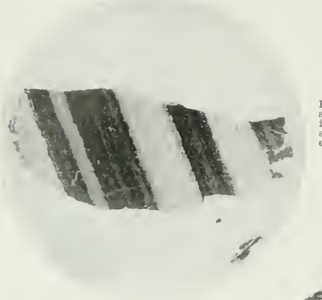


Fig. 1.—Photograph of thin section 211, showing a banded cherty iron carbonate from the Iron formation on Little Long lake. The dark bands are composed almost entirely of magnetite and chert, the lighter bands of iron carbonate and chert. Natural size X $2\frac{1}{2}$.

Fig.

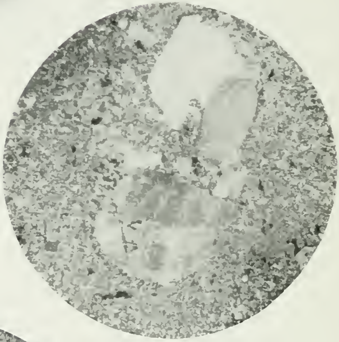


Fig. 2.—Photomicrograph of thin section 168, showing the re-absorption of a microcline crystal by the matrix. The other phenocrysts are not re-absorbed, possibly because they did not form until after the action on the round one occurred, or because they are of a different composition and not taken into solution so readily. Natural size X 22. Crossed nicols.

Fig. 2

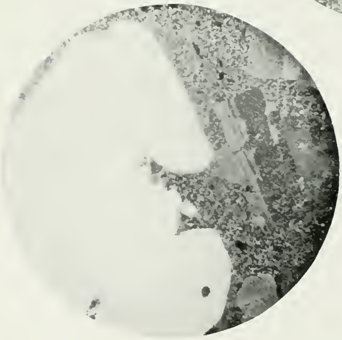


Fig. 3.—Photomicrograph of thin section 196, showing the re-absorptive action of the matrix of a rhyolite porphyry on the quartz phenocrysts. The effect of pressure in producing fracturing in the feldspars may also be seen. Natural size X 22. Crossed nicols.

Fig. 3

PLATE IV.

comparison of these rocks with those collected by Mr. W. H. Collins in the Gowganda district of Ontario shows many similarities. For purposes of comparison and the establishment of petrographic provinces it is desirable that geologists give definite descriptions of the diabase supposed to be of Keweenawan age.

These dikes vary much in width, with a maximum of 150 feet. Their strike is in general northwest by southeast and their dip vertical. Their distribution is widespread, as shown by the accompanying map, and it is probable that some of the scattered outcrops which only extend short distances before being lost in the drift should be connected up with one another. There are a few rather irregular masses, but they are doubtless connected below the surface with some of the dikes, as the latter in some cases expand into irregular masses or break up into numerous thread-like dikes. In places on the eastern portion of the southern range little dikes ramify over considerable areas.

It seems probable that these dikes owe their origin partly to the ease with which fissuring occurred during the adjustment of the rocks which must have occurred in the Nipigon basin after or during the transfer of such great quantities of lava toward the upper levels of the earth's crust. The dikes run in a direction which is roughly tangent to the border of this basin. In other parts of the Nipigon region dikes similar to these served as channels by which the diabase magma rose to form the great sills and sheets of the Keweenawan. These dikes may have served a similar purpose in this area, but there are no remnants of such masses to show that such was the case.

The contact metamorphic effects of these dikes have been inconspicuous. In most places the borders of the dike are very fine-grained, but there is often no observable change in the adjacent rocks. The chief evidence of alteration is found in the great amount of epidote developed in some of the slates and gray-wackés of the Iron formation. In these rocks little stringers of epidote occur, and innumerable microscopic crystals may be found in the thin section from rocks occurring within several feet of the dikes.

*Megascopic characters of the diabase*:—These rocks comprise a medium grained type of diabase. The feldspars are often yellowish on the weathered surface, as if they were partially altered to some mineral like epidote. Pyrite is a rather prominent constituent. The ophitic structure is not apparent, and the appearance of the rock is therefore more like that of gabbro.

*Microscopic characters*:—Thin section 199 may be taken as a type section of this rock. It is composed of labradorite feldspar, augite and ilmenite. In most cases the feldspar forms lath-shaped crystals, but the ophitic texture is not so well marked as in many diabases. In some cases the augite crystals are almost euhedral, and it is evident that the feldspar and augite crystals must have originated at about the same time. The augite is almost colorless, or shows a pink to light brown tint. It is generally pretty fresh, but the alteration to uralite may be seen along the borders of many crystals. A crystal of augite has one end composed of a green hornblende with an extinction angle different from that of the augite.

In a thin section from another point the augite is largely gone over into secondary hornblende, and many little epidote crystals are developed within this hornblende. Chlorite is common. The feldspars are much kaolinized, and contain considerable calcite as a weathering product. Pyrite forms an accessory mineral in small amounts.

According to a large number of measurements, the proportion of feldspar, augite and ilmenite in these diabases is approximately 55 per cent. of feldspar, 41 per cent. of augite and secondary hornblende, and 4 per cent. of ilmenite. The specific gravity is 2.88.

### Pleistocene Deposits

As one ascends the Red Paint river, high sand banks come into view. At the first portage above lake Nipigon a sand and silt plain, the shallow water deposit of a large glacial lake which covered much of the Nipigon region, stands 75 feet above the lake, and a continuation of this plain may be seen between this portage and the next one, five miles up stream. Proceeding towards the Height of Land, these sand banks, which were so prominent on the lower portion of the river, become much lower and just below the divide irregular hummocks of drift occur. These drift deposits show no evidence of a beach along their lower border, nor do they appear to have been covered by water. As the elevation of these hills is not more than 1,050 feet above the sea, and sand plains extending from lake Nipigon up the Sturgeon river south of

Fig. 21. Dry kettle in terminal moraine along Johnson creek.

the Onaman region reach an elevation of approximately 1,090 feet, it seems evident that the water of the glacial lake must have reached a level higher than the hills on the Red Paint river would indicate. It is possible, however, that warping may have caused the difference of level shown here. Considering the absence of beaches, the grading of the sand plain into hills of drift which do not appear to have been under water, and the fact that shallow water deposits of the glacial lake occur at a higher elevation a short distance south than the water line in this area, it is concluded that the ice must have formed the northern boundary of the lake when it stood at its highest level. Before the ice left this region the outlet of the lake must have been changed so as to permit a lowering of its level. It may be that a local advance of the ice deposited fresh morainic materials on the sand plain after the water retreated from this area.

As the writer has pointed out in a previous article[28], there is some difference of opinion as to which of the glacial lakes is responsible for these extensive sand and silt deposits. Prof. Coleman regards these deposits as belonging to lake Warren[29], while Goldthwait[30] and other writers in the United States do not consider that lake Warren ever covered the lake Superior basin. In the article referred to, Goldthwait has given an historical review of the work done on the Abandoned Shore Lines, and from that it would appear that the shores of lake Warren did not extend to the Nipigon basin and that the deposits above described belonged to lake Algonquin.

Around the head waters of the Red Paint river and for several miles down the north side of Johnson creek there is a series of fine terminal moraine hills which stand

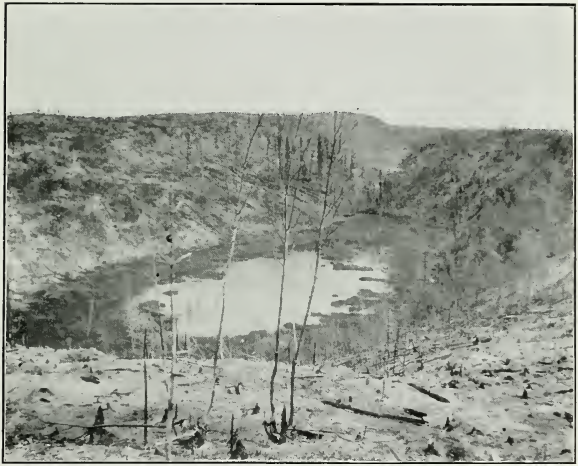


Fig. 22. Kettle lake in terminal moraine along Johnson creek.

out distinctly because they have been completely denuded of vegetation by forest fires. (Fig. 5). These moraines mark the position held by the front of the glacier for a long period, and contain many kettle lakes which may have been due to buried masses of ice melting out after the retreat of the main ice-sheet and permitting a slumping of the overlying sand and gravel (Figs. 21 and 22). As many as five of these kettles, or lakes without outlets, have been included in a single photograph (Fig. 5).

On the south side of Johnson creek another group of four kettles appears in a group of hills which represent the position of a lobe of the ice which extended a little in advance of the main mass.

[28] Geology of the Lake Wendigokan Region. Transactions of the Canadian Institute, Vol. VIII., p. 361.
[29] 17th Rept. Bureau of Mines, 1908, p. 167.
[30] Bull. 17, Wisconsin Geol. and Nat. Hist. Survey.

The series of morainic hills occurring in this area extends westward for at least ten miles, with a maximum altitude of 1,200 feet, and eastward as far as the eye can reach. In connection with this moraine only two small eskers were seen. They extend, with serpentine outlines, in a southwest direction away from the foot of the hills. The kames are not prominently developed. The drift is composed of sand, gravel and coarse boulders composed of granite, greenstone and a great variety of other rocks, among which small chert pebbles are very common. Around Red Paint lake and the camps on the Height of Land portage, the drift pebbles are whitened with a coating of calcium carbonate. There are two probable sources for this mineral, viz.: the limestones of the Hudson Bay basin, and the calcite so plentiful in the weathered Keewatin greenstones. As this white coating has not been observed in any such quantity in the drift farther south in the region north of lake Superior, it seems more likely that the limestones are the source of it.

The direction of the ice striations, where noted, is, on the average, $60^\circ$ (N. $60^\circ$ E.). On some of the jaspers a glassy polish has remained almost perfect until the present day, and shows how little has been the effect of the thousands of years of weathering to which these rocks have been subject since the ice age.

### A Recent Deposit; Travertine

Red Paint lake is fed entirely by springs issuing from the drift beneath its surface, as no superficial stream can be seen entering this lake. The name seems inappropriate for the lake, as the water is a charming, deep blue color. This color seems to be due to the lack of earthy sediments in the water and possibly to the presence of white calcium carbonate on the bottom and disseminated through the water. This white sediment must have an influence on the absorption of the rays of light and in the production of the blue color, because Blue lake, in the southern portion of the district, contains some of this sediment and is also remarkably blue. No other lake in the region possesses a similar deposit or anything like such a blue color. The deposit of calcium carbonate, or travertine, in Red Paint lake is at least 20 feet deep at the southeastern end, as a pole can be thrust down into it to that depth. Around other portions of the lake the deposit varies greatly in thickness and may even be lacking. The creek leaving the lake is so saturated with calcium carbonate that it deposits travertine on the roots and stems of plants along its course, and on the bottoms of the upper lakes of the Red Paint river. As already pointed out in the previous section, the source of this mineral is probably the calcium carbonate found on the pebbles of the drift in the surrounding region, and originally derived from the limestones of the Hudson Bay slope. Were this deposit favorably situated, it might be used in the manufacture of cement, but there is no prospect, so far as can be seen at the present time, of its becoming of economic value. Even the coming of the new railroad is not likely to awaken any industrial interest in a region so isolated and so far removed from the centres of population.

### Summary

The Onaman Iron Range district covers about 70 square miles and lies between 45 and 50 miles up the Red Paint river, northeast of lake Nipigon. The Keewatin, Laurentian, Huronian, Keweenawan, Pleistocene and Recent rock systems are represented. The Keewatin consists of an older complex series of basic rocks cut and overflowed by an acid series which are in turn overlain by a thin series of pyroclastics grading into sediments. These pyroclastics are overlain conformably by a banded Iron formation, and in one place this formation seems to be cut and overflowed by the acid rocks. The basic rocks consist of both intrusives and extrusives, and are composed largely of gabbros and diabases. The acid rocks consist of rhyolites, rhyolite-porphyries and feldspar porphyries. The former rocks seem to constitute the matrix of the

pyroclastics in small areas. The pyroclastics consist of tuffs and agglomerates, which grade over into conglomerates with waterworn fragments and a sedimentary matrix. The fragments consist almost entirely of rhyolite. The Iron formation occurs in two bands called the northern and southern ranges, the former extending, as indicated on the accompanying map, almost across the area from east to west. The latter range does not outcrop for more than about three miles, but seems to extend for some distance farther under a swamp. The formation is composed largely of red jasper, often well banded, and magnetite. There are considerable deposits of these minerals, but they are interbanded with a large amount of slate and some graywacké. Some tuffs may also be interbedded with these materials. The formation does not at present contain "pay" ore, though much low grade material exists. There is evidence that the original mineral from which a considerable proportion of the hematite and magnetite has been derived was iron carbonate.

The Keewatin rocks have been cut by the Laurentian granite which now exists as a hornblende gneiss, grading, in places, into granite. The Huronian system is represented only by a couple of small outcrops of hornblende-porphyry and possibly two dikes of diorite which cut the Iron formation. The Keweenawan rocks occur as large dikes of diabase which cut across the district in a general north and south direction.

The drift is thick in many parts of the area, and an interesting series of terminal moraines contains numerous kettle lakes along Johnson creek. The sand plains formed in the shallow water of the glacial lake, Algonquin, may be traced from lake Nipigon up the Red Paint river to the Height of Land near its head waters, where the plain appears to be covered by terminal moraine deposits. The drift pebbles on the Height of Land are often coated with calcium carbonate which seems to have been the source of the travertine deposited by streams feeding Red Paint lake.

Two items of interest here are the occurrence of dumortierite in jasper and slate, and tourmaline in rhyolite and rhyolite-porphyry. The dumortierite is a rare mineral and has never before been reported from the iron ranges. The tourmaline is probably secondary in the rhyolite but it seems to be primary in the rhyolite-porphyry, and its association with this type of rock has not been frequently observed in other regions.

# IRON FORMATION OF WOMAN RIVER AREA

By R C ALLEN

Recent work by foremost students of the geology of the Lake Superior region has indicated that a genetic relationship exists between the Iron formations and extrusive basic igneous rocks of contemporaneous origin. It has been recognized that the Iron formations are essentially sedimentary rocks, but the question has been raised whether the materials were mainly derived through erosive processes, or whether they were derived more largely through igneous action. Observations by the writer in the Woman River district are in most perfect accord with the latter conception, and inasmuch as this view is contrary to the one generally held, it is believed that a brief consideration of the relations of the Iron formation to the associated igneous rocks will have more than a local significance.

## Situation of the Range

The Woman River Iron range, as here designated, is a belt of iron-bearing rocks which extends from the vicinity of the northeast end of Rush lake in the Sudbury Mining Division in a general southwesterly direction for about 11 miles. The belt is crossed by the Woman river at a point about 22 miles almost due north of Ramsay station, and can be reached in two days by canoe from any one of three different points on the Canadian Pacific railway, viz., Biscotasing, Woman River and Rideout. All things considered, the route from Biscotasing is the most desirable. It follows the old Hudson's Bay Company route to Flying Post as far as the northwest arm of lake Opeespeesway, thence down the Opeespeesway river to its junction with the Woman river, thence down the Woman river about a quarter of a mile, whence a good trail leads westward over the range. The following description applies mainly to certain claims designated W.S., 1 to 12 in which is included that part of the range which lies west of Woman river.

West of the Woman river the Iron formation occurs in three main belts. (See map).

Belt 1 begins in the southeast corner of claim W.S. 10, runs northeastward to W.S. 12, across the northeast corner of W.S. 12 into W.S. 11, and then north 700 paces where it is lost in a marsh and completely cut off on the north, east and west by hills of ellipsoidal greenstone. This belt is probably double at the southeast, where it has an extreme width of 300 paces which decreases to about 400 feet at the north end.

Belt 2 begins on the east border of W.S. 10 about 1,320 feet north of the southeast corner of the claim, and runs northward and eastward along the crest and flanks of a high ridge in W.S. 9 and 8 to the north side of W.S. 8, where the ridge ends abruptly in a swamp underlain by greenstone. The maximum width of this belt is about 1,400 feet.

Belt 3 begins north of the marsh in the southeast corner of W.S. 8 and runs north along the east side of this claim and into W.S. 7 for a distance of about 400 paces, where it is cut out by ellipsoidal greenstone and volcanic breccia. The Iron formation reappears about 75 paces west and 1,100 paces north of the southeast corner of W.S. 7, and forms a continuous belt thence northeastward to within about 400 paces of Woman river, where it is again cut out by greenstone.

East of Woman river the Iron formation extends in a more or less continuous belt to the northwest arm of Rush lake.

## Geology and Structure of the Range

The rock succession, as developed on that part of the range west of Woman river, from the youngest to the oldest, is indicated in the following table.

| | |
|---|---|
| Basic Igneous Dikes. | Relative ages not known, but believed to be as shown. |
| Mica Porphyry. | |
| Acid Igneous Rocks. | Extrusive and Intrusive. |
| Iron Formation. | |
| Basal Greenstones. | |

On the northeast end of the range in the vicinity of Rush lake, granite is reported intrusive in the Iron formation.

The strike of the banding in the Iron formation on claim W.S. 8 and northward is on the average about N. 45 degrees east but in Belt 1, it is nearly at right angles to this direction. Locally, the general strike is interrupted by minor folding, which is often accompanied by excessive brecciation. The formation is nearly everywhere in almost vertical position. In Belt 1 the dip is toward the northeast; in W.S. 8 and northward toward the southeast.

The basal greenstones and the Iron formation are intruded by many light colored dikes of rhyolite porphyry. Acid volcanic breccia occupies a considerable area chiefly east of the Iron formation in claim W.S. 8 and northward. In places there are gradational phases between dikes of rhyolite porphyry and the breccia, indicating that the latter rock is an extrusive phase of the former. Near the southeast corner of claim W.S. 7 the breccia is massively bedded and dips about 45 degrees to the northwest, but this is the only locality where bedding was observed in this formation. A peculiar dike rock which has been called mica porphyry intrudes the breccia near the middle of claim W.S. 8. It has a dense very fine grained felsitic ground mass, in which are embedded numerous well developed porphyritic crystals of white mica. Basic dikes intrude the volcanic breccia and the Iron formation but they are much less numerous than the rhyolite dikes.

### The Basal Greenstones

The distinguishing general characteristics of the basal greenstones are an epidote green color, their mashed and minutely fractured condition, the abundance of calcite lining the fracture planes in thin films, and the ellipsoidal structure. The ellipsoidal structure is not everywhere present, but its occurrence is so general that a separation of the distinctly ellipsoidal greenstones from the phases in which this structure is absent would be impossible in mapping. Some phases of the greenstone seem to be later than others, but to establish a succession would be extremely difficult. Certain phases which in one locality appear to be in intrusive contact, in another locality not far away may grade into one another almost imperceptibly.

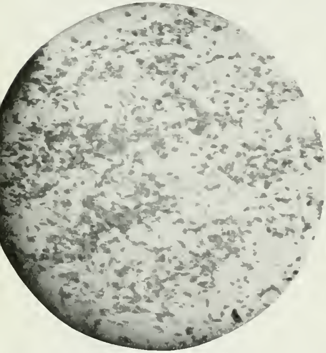
In texture these rocks are usually very dense and fine grained, but occasionally a crystalline structure can be made out without the use of a lens. They are exactly similar to the ellipsoidal greenstones of the Vermilion district of Minnesota and the Crystal Falls district of Michigan, described in Monographs 36 and 45 of the United States Geological Survey, to which the reader is referred for detailed descriptions.

### The Iron Formation

The iron formation is made up of finely banded cherty iron carbonate rocks, hematitic, magnetitic, and pyritic cherts, black and red jaspilites, a unique amphibole-magnetite-chert rock, and iron ores.

*The Cherty Iron Carbonate Rocks*:—Unaltered cherty iron carbonate rocks are present in only a few local areas, but iron carbonate as a mineral is widely distributed in the various phases of the formation. The cherty iron carbonate rocks are finely banded, dense and finely granular textured, gray on fresh surfaces, but weathering to a rusty brown color. In the unaltered phases the iron carbonate occurs in irregular bands in a matrix of finely granular silica. It is most commonly in clear, almost colorless to light yellow grains, but rarely occurs in well defined rhombohedral crystals. Qualitative tests reveal the presence of small amounts of calcium and magnesium, which are doubtless present in combination with the iron carbonate. The appearance of the unaltered iron carbonate rock under the microscope is shown in figure 1.

*The Jaspilites*:—In the jaspilites, bands of almost pure chert alternate with cherty bands carrying finely disseminated iron oxide in the form of hematite (red jaspilite) and magnetite (black jaspilite). The alternating bands are usually not more than an inch in width. A microscopic examination of these rocks shows clearly that most of the hematite has developed through the oxidation of iron carbonate. There is



ig. 1. Cherty iron carbonate rock from claim W S 6, in arallel polarized light. Magnified 15 diameters. The darker areas are iron carbonate, the lighter areas chert.

Fig. 2. Hematitic-magnetitic-sideritic chert in parallel polarized light. Magnified 70 diameters. The dark clouded areas are chiefly red hematite with a little iron carbonate in various stages of alteration to hematite. The dark colored grains in the light areas are magnetite.

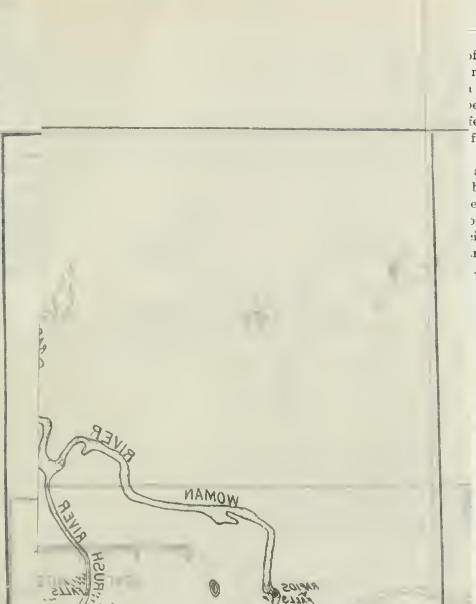
also evidence in some slides that at least part of the magnetite is secondary, but whether it developed from iron carbonate or hematite is not apparent. Under the anamorphic conditions through which these rocks have passed, magnetite could have formed in the presence of pyrite from either iron carbonate or hematite.[1] In the slides examined magnetite occurs sometimes with iron carbonate and sometimes without it, but when iron carbonate is present magnetite is also found.

In some jaspilites carrying magnetite, hematite and iron carbonate, the magnetite occurs in grains usually showing a tendency toward crystal outlines and surrounded by a more or less circular area in which the only mineral is chert. This phenomenon may be interpreted as indicating the secondary growth of the magnetite grains by a process of absorption of the iron in the areas adjacent to the growing crystals. Under the microscope these rocks have a peculiar mottled appearance as shown in figure 2.

[1] Van Hise, C. R., Monograph, 47, United States Geological Survey, pp. 845-846.

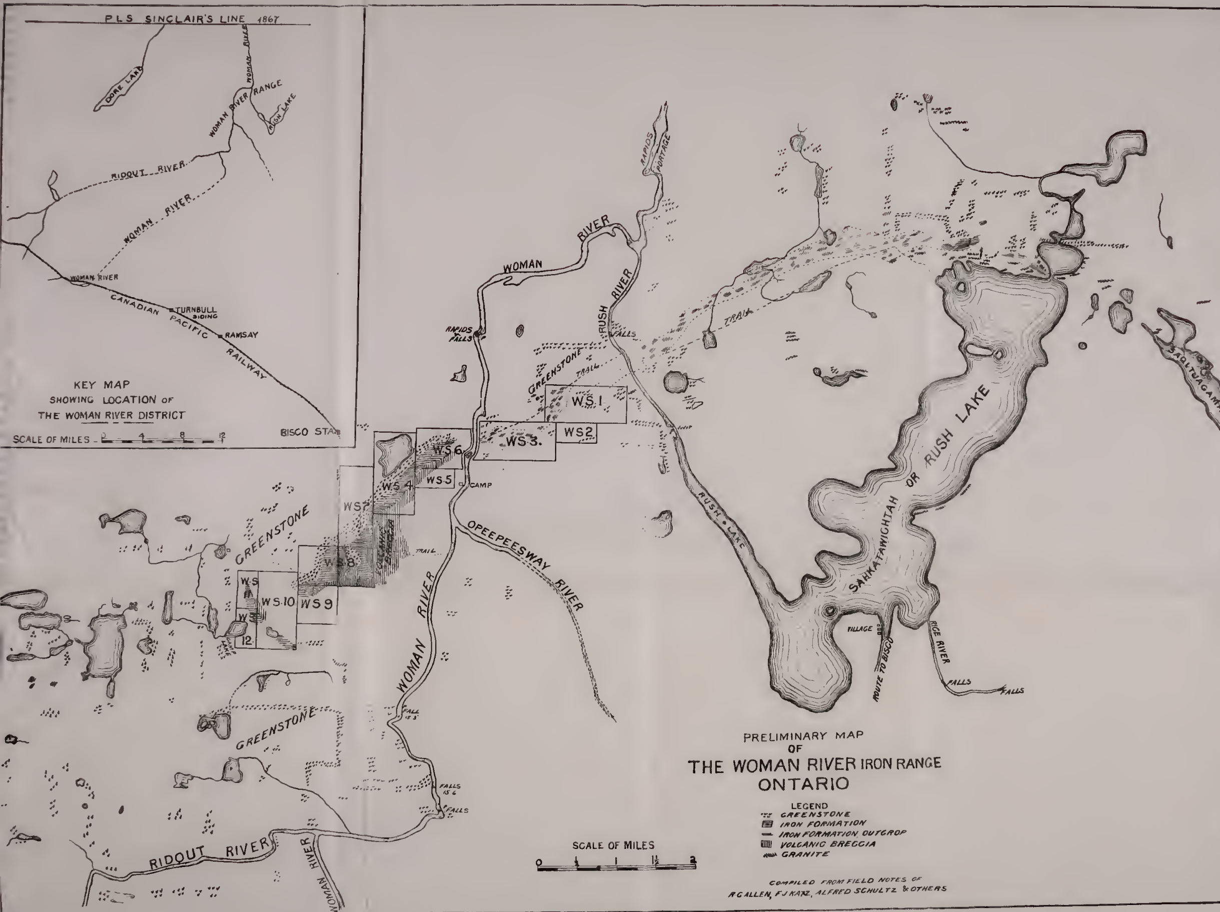
ɔf the Iron
rocks have
ı carbonate
ɔe observed
ferruginous
favor of a

aggregates
brous blue
e. It was
ɔf chemical
imen from
nd magne-
.017. The



ɔf Wiscon-
imen indi-

associated
a schistose
It occurs
s it shows
ount, the
ɔf several
amphibole
d on the
herty iron
minerals
d in asso-


P.L.S. SINCLAIR'S LINE 1867
DORE LAKE
WOMAN RIVER
WOMAN RIVER RANGE
RUSH LAKE
RIDOUT RIVER
WOMAN RIVER
WOMAN RIVER
CANADIAN PACIFIC RAILWAY
TURNBULL SIDING
RAMSAY
KEY MAP
SHOWING LOCATION OF
THE WOMAN RIVER DISTRICT
SCALE OF MILES 0 4 8 12
BISCO STA.
WOMAN RIVER
RAPIDS PORTAGE
RUSH RIVER
RAPIDS FALLS
FALLS
TRAIL
GREENSTONE
TRAIL
W.S.1
W.S.2
W.S.3.
W.S.6
W.S.4
W.S.5
CAMP
W.S.7
GREENSTONE
VOLCANIC BRECCIA
TRAIL
W.S.8
W.S.9
W.S.10
W.S.11
W.S.
12
OPEEPEESWAY RIVER
WOMAN RIVER
WOMAN RIVER
RUSH LAKE
SAHKATAWICHTAH OR RUSH LAKE
SAGITUAGAMA L.
VILLAGE
ROUTE TO BISCO
RICE RIVER
FALLS
FALLS
GREENSTONE
FALLS
FALLS
RIDOUT RIVER
WOMAN RIVER
PRELIMINARY MAP
OF
THE WOMAN RIVER IRON RANGE
ONTARIO
LEGEND
GREENSTONE
IRON FORMATION
IRON FORMATION OUTCROP
VOLCANIC BRECCIA
GRANITE
SCALE OF MILES
0 ½ 1 1½ 2
COMPILED FROM FIELD NOTES OF
R.C. ALLEN, F.J. KATZ, ALFRED SCHULTZ & OTHERS

*Ferruginous cherts*:—Ferruginous cherts make up a very large part of the Iron formation. Here, as in other ranges of the Lake Superior region, these rocks have been formed through the oxidation of the iron carbonate of the cherty iron carbonate rocks. All stages in the process of oxidation of the iron carbonate may be observed under the microscope. It is possible that some of the hematite in the ferruginous cherts is original, but in the slides examined the indications are all in favor of a secondary origin for all of the hematite in these rocks. (Figure 3.)

*Amphibole-magnetite rocks*:—The amphibole magnetite rocks consist of aggregates in various proportions of three minerals, viz., chert, magnetite, and a fibrous blue amphibole which in its petrographic properties closely resembles riebeckite. It was not found possible to separate the amphibole from the rock for the purpose of chemical analysis. An analysis by Lerch Brothers of Biwabik, Minnesota, of a specimen from claim W.S. 8 which consisted largely of the amphibole mineral with chert and magnetite gave Fe 41.35, $SiO_2$ 34.6. $Al_2O_3$ .24, CaO .06, MgO .12, S .279, P .017. The

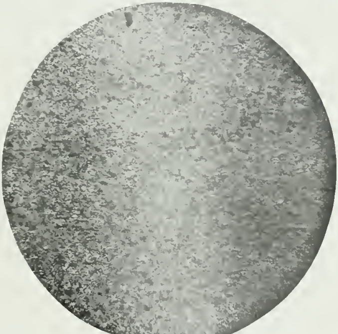


Fig. 3. Ferruginous chert in parallel polarized light. Magnified 70 diameters. The clouded areas are chiefly hematite with iron carbonate in various styles of alteration to hematite. The finely granular texture of the chert is well shown.

specimen was tested for the alkalies by Dr. R. D. Hall of the University of Wisconsin, and these were found present only in traces. The analysis of this specimen indicates that the amphibole is probably mainly an iron silicate.

In claim W.S. 8, where the amphibole is very abundant, it is especially associated with the highly brecciated parts of the Iron formation where it often forms a schistose matrix in which are embedded displaced fragments of chert and jasper. It occurs also with magnetite in rocks which consist mainly of chert. In these rocks it shows no tendency toward parallel arrangement. When present in large amount, the amphibole imparts a blue color to the rock. Microscopic examination of several specimens of the amphibole rocks throws little light on the origin of the amphibole mineral. According to Van Hise amphibole-magnetite rocks have developed on the Penokee-Gogebic range by metamorphism under anamorphic conditions of cherty iron carbonate.[2] There the amphibole is actinolite and grünerite, and with these minerals is associated residual iron carbonate. Iron carbonate has not been observed in asso-

[2] Monograph 19, United States Geological Survey, pp. 257-260.

ciation with the amphibole mineral of the Woman River range, but its absence there is probably due to complete decarbonization of the iron carbonate and conversion of the iron into magnetite and silicate. The occurrence of abundant amphibole in the most highly brecciated parts of the Iron formation is considered strong evidence of such an origin. Frequently the amphibole mineral is associated with extremely minute flakes of mica. The appearance of one phase of the cherty amphibole-magnetite rock under the microscope is shown in figure 4.

*Iron Ores*:—Locally, particularly in claims W.S. 11 and 12, iron ores occur. On these claims the ore is low grade, running as high as 43 per cent. iron and, as shown by an average of 16 analyses, carrying a phosphorus content of .018. On claim W.S. 8 the most highly ferruginous areas coincide with those that are abundantly amphibole-bearing. Samples from these areas show an iron content varying up to 43 per cent., with an average phosphorous content of .0127. A small amount of sulphur is present as pyrite. An average of 8 determinations gave 1.184 per cent., but these

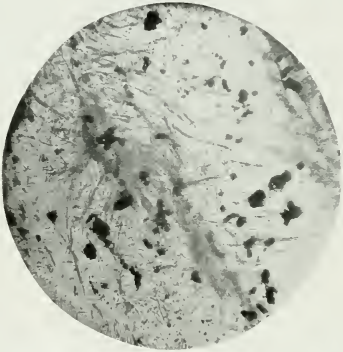


Fig. 4.—Amphibolitic-magnetitic chert in parallel polarized light. Magnified 320 diameters. The amphibole occurs in slender acicular crystals associated with magnetite and chert.

samples were selected for analysis because of their relatively high sulphur content, which makes it certain that the figure stated is higher than the general average.

The occurrences of ore can not be connected with the present topographic and structural features of the range. In Belt 1 and in claim W.S. 8 the ore is in the upper part of the formation, and on hill slopes or under slopes where the dip of the banding and the slope of the rock surface is in the same direction, but these relations seem to be purely accidental. The distribution of the iron in the formation antedates the deep-seated deformation and metamorphism of the rocks, in which both the lean and the more highly ferruginous phases were involved.

*Variations in the Mineralogical Character of the Iron Formation*:—Great variability in character of the Iron formation both in the direction of strike and across it, is a marked feature of all of the belts, yet in a broad way the range may be divided into several areas, each of which is characterized by the relative prominence of one of the various phases of the formation. In general, ferruginous cherts are dominant toward the southwestern end, and the jaspilites are prominent toward the northeast

in claims W.S. 4, 5, and 6. The amphibole magnetite rocks are abundant in claim W.S. 8, while the unaltered iron carbonate rocks have been found only in claim W.S. 6 and in a few places east of Woman river.

The minerals, iron carbonate, hematite, magnetite, and pyrite, may be present in varying amount in all of the phases of the formation except in the amphibole magnetite rocks, where iron carbonate has not yet been found; however, the number of thin sections examined is too small to warrant the statement that iron carbonate is totally wanting in these rocks. Chert is abundantly present in all the rocks of the Iron formation, and in certain places near its base in claim W.S. 7 it exists almost to the exclusion of all other minerals. The various cherty rocks may be designated as hematitic, magnetitic, pyritic, or amphibolitic, according as one or the other of these minerals is most prominent. Sometimes several of them may be nearly equally developed in the rock, as is the case in the specimen shown in thin section in figure 5.

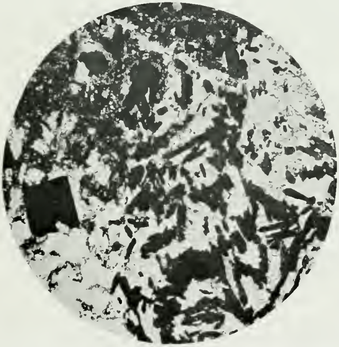


Fig. 5.—Hematitic-pyritic-sideritic chert in parallel polarized light. Magnified 70 diameters. The hematite is in specular form and shows a marked tendency toward long lath-shaped crystals. The iron carbonate is distinguished from the chert by its high relief. Pyrite is shown in characteristic square section.

### The Volcanic Breccia

The pyroclastic character of this rock is plainly shown by its relation to certain dikes of rhyolite porphyry already referred to, and also by its composition and texture. The most prominently developed phase is an aggregate of angular to sub-angular fragments of rhyolite porphyry, embedded in a fine grained matrix of greenish color which is frequently schistose. The fragments vary greatly in size up to six or seven inches in diameter. The fragments of various sizes are mixed in haphazard manner and show none of the sorting effect of wave or current action. From the coarse fragmental phases of the formation there are gradations into normal rhyolite porphyry. This was observed in claim W.S. 8, as mentioned above, and various stages in the process of gradation may be observed in other parts of the field. For instance, near the east line and about 450 paces north of the southeast corner of claim W.S. 7, there is a large outcrop which appears from ordinary inspection to be massive rhyolite porphyry.

On close examination the fragmental structure of this rock is apparent. but the outlines of the fragments are faint and indistinct, and they are in a matrix which is exactly similar to the normal rhyolite porphyry of the massive phases. This rock is undoubtedly a gradational phase between the normal massive white rhyolite porphyry which is in contact with the Iron formation about 150 paces east, and the coarse breccia which is exposed about the same distance northeast, and it seems to be, stratigraphically, between the two. In one outcrop on claim W.S. 7 the breccia is in sharp contact with the Iron formation, but this relation is not general, as these two rocks are frequently separated by rhyolite porphyry. The dip of the breccia was observed in only one place, *i.e.*, near the southeast corner of claim W.S. 7. but the attitude of the formation as a whole may be inferred from its distribution with reference to the Iron formation. It has been noted that the breccia occurs, so far as known, on the east or dip side of the Iron formation, which indicates that the two formations are folded together in at least approximate structural conformity.

The dikes of mica porphyry which cut the breccia near the middle of claim W.S. 8, as mentioned above, are probably practically contemporaneous in age with the rhyolite porphyry and breccia, and the three rocks should perhaps be considered as differentiated phases of a common original magma.

#### The Iron Formation and the Associated Igneous Rocks

It is the purpose in this paper to avoid a general discussion of the origin of the Iron formation. However, the significance of its physical relationships to the associated igneous rocks will be pointed out in the hope of assisting in the solution of the larger problem of the origin of the Iron formations of the Lake Superior region in general.

For the sake of clearness and brevity, the problem will be stated in the form of four main premisses, viz., (1) the iron formation is essentially a sedimentary rock; (2) the physical relations between the Iron formation and the basal greenstones are those of conformity in the sense that the two formations are not separated in time by a period of subaerial erosion; (3) the Iron formation and the overlying rhyolite porphyry and breccia are conformable in the same sense; (4) the Iron formation is genetically related to the extrusive igneous rocks with which it is conformably associated.

The sedimentary character of Iron formations of the general type herein described has been established beyond doubt in other parts of the Lake Superior region. Without reference to other districts, the sedimentary nature of the Iron formation in this area may be inferred from (1) its banded structure, (2) the presence of iron carbonate as an original mineral, and (3) the parallelism of the individual bands in the rock to each other and to the basal contact plane.

The belief that the relations between the Iron formation and the basal greenstones are those of conformity, is based upon (1) the parallelism of the banding in the Iron formation to the plane of contact with the greenstones, (2) the absence of detrital materials in the Iron formation, or between it and the basal greenstones, (3) the probable sub-aqueous origin of the ellipsoidal greenstones. The contact between the Iron formation and the basal greenstone is abrupt and is parallel to the banding in the Iron formation. This relation has been observed by the writer and others in many natural exposures, and in pits and trenches, and is believed to be general on the range. Under normal conditions an erosional unconformity is evidenced by the occurrence, somewhere at the base of the superjacent series, of mechanical sediments derived from the underlying rocks. The evidence of conformity in the apparent absence of basal clastics might be waived in so small an area, were it not for the fact that such materials are totally wanting in the formation as a whole.

The evidence of conformity offered by the absence of fragmental materials in the Iron formation is in accord with the supposed sub-aqueous origin of the ellipsoidal

greenstones. These rocks are well developed in many areas in the Lake Superior region, and in some localities as in the Mansfield area of the Crystal Falls district of Michigan, they are interbedded with slates in such manner as to leave little doubt of their sub-aqueous origin.

If a sub-aqueous origin for the basal greenstones of the Woman River district be accepted, the difficulties in the way of an understanding of the physiographic relations between them and the Iron formation are largely eliminated. It is conceived that the deposition of the Iron formation quickly followed the extrusion of basic lavas on the floor of an area which was submerged. This would account for the absence of basal detrital materials. The apparent total absence of clastics in the Iron formation may be due to rapid precipitation which might obscure a relatively very small amount of silt, or it may be due in part to physiographic conditions which were unfavorable to the deposition of mechanical sediments.

Unfortunately, there is no absolutely conclusive evidence as to the conformity of the Iron formation and the rhyolite porphyry and breccia formations, but such evidence as there is favors this view. Wherever observed, the contact between the two formations is sharp, like that between the Iron formation and the basal greenstones. The plane of contact is also parallel to the banding in the Iron formation, except where the banding is obscured by brecciation, but the number of observations is insufficient to establish this as a general relation. An objection to the theory of conformity might be offered in the great variations of thickness of the Iron formation in so small an area, but these variations are mainly apparent and not real. For instance, the apparent greatly increased thickness of the Iron formation in Belt 2 is plainly due to crumpling and intrusion.

### Igneous Origin of Iron Formation

The belief that the deposition of the Iron formation in this area was closely connected with igneous action is based on observations here and in other areas, but mainly on the unpublished work of Prof. C. K. Leith, which is soon to appear in print; and the full significance of the Woman River area will appear only after the publication of Prof. Leith's work.

As interpreted from the observational facts given above, the physical development of the Woman River section may be briefly stated as follows: extrusions of basic lavas on the floor of a submerged area were quickly followed by the precipitation of the Iron formation. Thus is explained the absence of mechanical sediments between these formations; and the apparent absence of such sediments within the Iron formation itself may be accounted for by a relative rapid precipitation, since this would tend to obscure the presence of very minute amounts of intermixed silt. It is also possible that it may be due in part to physiographic conditions which were unfavorable to the deposition of mechanical sediments. The deposition of the Iron formation was probably terminated by the recurrence of extrusive processes, which produced the rhyolite porphyry and breccia formations.

The basic greenstones at the bottom of the series, the Iron formation in an intermediate position, and the rhyolite porphyry and breccia at the top of the series, are thus thought to be inter-related in origin. The greenstones and the quartz porphyry and breccia formations are probably consanguineous in the sense in which this term is used by Iddings.[3]

The igneous relationships of the Iron formation are too complex for satisfactory statement in brief. It will suffice for present purposes to say that the source of the materials has been referred mainly to the extrusion of magmatic waters following the sub-aqueous outpourings of basic lavas which formed the greenstones. From the

[3] Iddings, Joseph P., Genetic Relationships Among Igneous Rocks, Journal of Geology, Vol. I., p. 842.

materials thus contributed, the Iron formation was precipitated to form a sedimentary rock. In a sense, then, the Iron formation and the basic greenstones are products of magmatic differentiation, and as the former is very basic and the latter is very acid, they may be considered perhaps as widely differentiated phases of a magma of intermediate composition. If this conception be the correct one, there is in the conformable series of greenstones, Iron formation, and rhyolite porphyry and breccia of this district, a record of more or less continuous igneous activity, and it is not improbable that in a broad sense these three formations are widely differentiated phases of a single parent magma. Whether this be the correct interpretation or not, the writer does not here attempt to pronounce, but in view of the physical relationships of the Iron formation to the igneous rocks of this district the burden of proof is upon those who would deny an essentially igneous origin of the Iron formation.

[4] The Iron formation, on the whole, contains probably 80 per cent. of silica.

# LAKE ABITIBI AREA

By M B BAKER

In view of the marked activity in prospecting for gold in the Abitibi district during the summers of 1906 and 1907 it was deemed advisable to have the area geologically mapped. Accordingly in April, 1908, I received instructions from Mr. Thomas W. Gibson, Deputy Minister of Mines for Ontario, to proceed with a party to lake Abitibi and make a geological survey of the Lower lake, and as much of the Upper lake as time would permit, and also to prepare a map of the geology of the district.

On the Abitibi river.

My party consisted of three student assistants from the School of Mining, Kingston. They were N. L. Bowen, M.A., E. L. Bruce and J. S. King, and I cannot speak too highly of the valuable services rendered by all these gentlemen. Most of our work was done by dividing the party and working in pairs, Mr. Bowen taking one man, and I the other. Mr. Bowen must therefore be credited with a large share of the field work.

## Route of Access

Proceeding to Matheson, the terminus of the Temiskaming and Northern Ontario railway, we procured canoes and provisions and left on May 29th, proceeding down the Black river. At a distance of 14 miles from Macdougall's Chute, the town of

which Matheson is the station, we reached the junction of the Abitibi river. This part of the journey is easily made, as the stream is simply a deep, quiet river, with scarcely any current, and offering no hindrance to navigation either up or down stream.

On reaching the Abitibi river, however, very different conditions were found. This splendid river, from 80 to 150 yards in width, flows with a very strong current; and in many places there are rapids. Some of these are very treacherous. As the route will be much used in the future, as it has been in the past, by travellers, hunters, and others, and will likely prove an interesting one for tourists, it is perhaps advisable that a rather detailed description of it should be in print. Speaking personally, I would have valued such a description when making the trip myself, and I am sure that other travellers without guides, will experience the same uneasiness in trying to follow the course without some such directions.

Leaving the mouth of the Black river, then, we proceed upstream against a comparatively strong current for a distance of three miles. At the end of this we come to one mile of very fast water, which brings us to the foot of the first portage. This point is known as the Twin falls, for here are two waterfalls about one hundred yards apart, separated by a deep pool at the foot of the upper one. The lower fall has a drop of about six feet through two gaps in a ridge of Keewatin schist. The upper fall is about eight feet. Two short portages on the south shore, with the use of the canoe to cross the pool between, makes the passage of this Twin falls quite easy. Above the falls there are two miles of fast water, followed by one and a half miles of quiet water, which brings us to the foot of the second rapid, called the Black Cat. This is portaged on the north shore by a carry of about two hundred feet. For the next three miles the water is quiet, and at the end of this distance there is a large tributary known as the Misto-ogo river, which is about forty yards wide and enters from the north. This river is navigable for canoes for a distance of thirteen miles, from which point a good road built by the contractors of the Grand Trunk Pacific railway, leads to the construction camps on the right of way. Immediately above the entrance of the Misto-ogo there is swift water, which continues for a mile and a half. Two stiff rapids are met with in this distance. The first is about three-quarters of a mile above the mouth of the Misto-ogo river, and is called the Flat rapids. The portage is about one hundred and fifty yards in length and is on the south bank of the river. About a quarter of a mile farther upstream is another treacherous rapid, called the Crooked rapids. This is a long, rough, and as the name indicates, tortuous, rapid: but it can be passed on the south shore by a carry of two hundred and fifty yards—across the arc of a circle as it were.

About three quarters of a mile of quiet water brings us to the foot of the Island rapids, which gets its name because the stream is divided into two channels, by an island over which the portage of one hundred yards is made. With experienced guides or good canoemen all the portages with the exception of the one at Twin falls are unnecessary up to this point, as the rapids so far mentioned can all be poled. This Island rapid, however, must be portaged in ascending, though it can be run in descending, by keeping close to the left side of the north channel. Above the Island rapid, there are eight miles of quiet water to the foot of the Little Couchiching rapids, which is quite rough. A short lift of thirty yards, on the south shore is all the portage necessary here. Two miles of quiet water follows, to the foot of Couchiching falls, where there is a portage of half a mile on the south shore. Four miles of quiet water at the head of the falls brings us to the outlet at Lower lake Abitibi.

The above description of the canoe route from Matheson station to lake Abitibi will be found of value to those making the trip without guides. A steamer which formerly plied on lake Ontario about Deseronto and was known then as the Ranger, now, however, runs from Macdougall's Chute to the foot of Twin falls. Here a tramway has been built, by the Walsh Forwarding company, over which all freight, etc.,

is trammed to the head of the upper fall. A second steamer from the head of this fall runs to the foot of Couchiching falls, where there is another tramway half a mile in length. From the head of the fall a third steamboat will deliver passengers or freight to any point on lake Abitibi and for a considerable distance up the streams flowing into it. These boats are well equipped for carrying a few passengers, so that ladies made the trip during the summer of 1908 quite comfortably.

The building of the Temiskaming & Northern Ontario railway has made the above described route an easy one. Previously the regular route to Abitibi was by way of lake Temiskaming and the upper Ottawa waters, or what was known as the Quinze route. This was a week's trip, with the same equipment as now requires one and a half days. The Quinze route to the Abitibi country and thence via the Abitibi river and Moose river, to Hudson bay, was established and mapped as early as 1744. This is well shown by a map issued in that year by N. Bellin, (Ingenieur, et Hydrographe de la Marine). But all the country north of lake Nipissing is marked in that map as "entirement inconnu," and it has remained almost unknown till very recently.

Characteristic shore of Abitibi.

As early as 1755 the Hudson's Bay Company established a post at Abitibi, but until the Canadian Pacific railway was built to Mattawa the trade route to Abitibi was via Hudson bay, so that the region between Abitibi and the Great lakes remained unknown except as a hunting ground until recent years. Exploration parties were sent to Abitibi by the Dominion Government under Mr. Walter McOuat, in 1872-3[1] and under Mr. William Ogilvie in 1891.[2] But the country southwest of Abitibi was not much explored till the summer of 1900, when the Ontario Government sent out exploration parties, including surveyors, land and timber estimators and geologists, to report upon the northern region.

I was attached as one of the geologists to party No. 1, whose area embraced Abitibi, and which made a preliminary report on the geology, soil, timber, etc., of the Abitibi area (Report of the Survey and Exploration of Northern Ontario 1900). Last summer was, therefore, my second visit to this area.

Lake Abitibi is made up of two large expanses of water which are known as the Upper or Southern and Lower or Northern lake Abitibi. They are connected by a

[1] Rep. C. G. S., 1872-3.

[2] Report of Exploration Survey to Hudson Bay, by Wm. Ogilvie, 1891.

narrows, about four miles in length, and about two hundred yards in average width. Through this narrows there is a considerable current. Upper lake Abitibi covers an area of about one hundred and ninety square miles, about fifty square miles of it being in the Province of Quebec. The lake is about thirty-three miles long, and varies from three to eighteen miles in width, and has a shore line of about one hundred and fifty miles. It is very shallow as a whole, being rarely over ten feet in depth, and is dotted with islands of which there must be fully four hundred in the Upper lake alone. Lower lake Abitibi covers an area of one hundred and forty-five square miles, and has a shore line of one hundred and fifty miles. With the exception of a long sandy peninsula which stretches out into the middle of the lake, from the south shore, the rest of the body of water is nearly round, being seventeen miles from east to west, as against nineteen miles from north to south in its widest dimensions. This lake is a little deeper than the Upper lake, but is nevertheless quite shallow. It contains over two hundred and thirty islands, rather evenly distributed over the lake. The Lower lake was accurately surveyed during the winter of 1907 by Mr. T. B. Speight, O.L.S., of Toronto, and on his survey the geological map is based. The Upper lake, however, was not surveyed, and consequently the rough compass survey made by our party during the summer is necessarily inaccurate, more particularly in the size and location of the islands. This lake was surveyed during the winter of 1908.

## Topography of the Area

The country about lake Abitibi may be described as gently rolling, heavily covered with glacial drift. The rocks are all glaciated, and present the usual low, smooth-topped, polished appearance of the Canadian Archean in general. South of the Upper lake at a distance varying between three and twelve miles is a range of hills which are considerably higher than any of the surrounding country. From the top of one of these one can count fifteen other hills varying in altitude from three hundred and fifty to approximately six hundred feet. With the exception of these hills, the country mapped is quite low and rolling. As is usual in glaciated Archean areas many hollows are occupied by marshes, muskegs and small lakes. The shores of the lake itself are for the most part, low and sloping. Very few steep or cliff-like shores are to be found. Consequently the shore-lines pass off gradually into shallow water, with broad beaches which do not reach a depth of ten feet for a considerable distance from the shore. A main channel or possibly several channels between the various inlets are, however, quite deep. In some places, the captain of the steamboat informed me he had found the water seventy feet deep, but he also mentioned that if he got a few yards away from this channel he would have to feel his way along with a pole.

The generally level character of the country is also well shown by the profile of the Transcontinental railway, where for seventy miles with very few curves, so that irregularities were not avoided, there are not over eight rock-cuts, and the whole profile preserves an astonishingly even character. This railway will touch the Lower lake in three places, and cuts several tributaries flowing into both the Upper and Lower lakes, so that one of the best possible routes of transportation in connection with farming, or tourist travel in this whole district, will be in conjunction with a boat service on the lakes.

The country is well-watered. Many splendid streams with deep, slow-moving water flow into both lakes from all directions. The large streams are navigable in some cases up to eighteen miles, with a lake-going steamer. From the great depth of these streams and the channels in the lake itself, as has been already mentioned, it would appear that the whole area has suffered a comparatively recent depression, and hence many of these streams are in reality drowned channels. Moreover, it has been estimated that a lowering of Couchiching falls five feet by blasting away the rocks

would lower Abitibi lake till it would become little more than a series of winding streams. As showing the topography to be of recent origin, Mr. J. G. McMillan says:[3]

"The area is a plain, in all probability once the bed of a glacial-dammed lake. The only breaks in the general level are the depressions caused by the erosion of streams, a few isolated hills of the "roche moutonnées" type and some sand and gravel ridges of a morainic nature, which rise a few feet above the general level. Midway between the rivers of the region, are some depressed tracts, once the beds of shallow lakes, but now filled with peat and moss to a depth of four to twelve feet. It is in these muskeg areas that most of the tributaries of the larger rivers have their origin . . . . Erosion has not gone on to a marked extent . . . . Everywhere the valleys have a characteristic "V" shape. At a short distance from the rivers, usually about ten chains, the general level of the plain is reached; while the tributaries entering the main streams have valleys usually not greater than ten chains in width. At no point is there a valley wider than half a mile."

Raft of logs on Abitibi.

### Soil and Timber

Over almost the whole of the area there is a good sandy clay loam, which will be described later as the Saugeen clay. This clay is so mixed with sand and so free from large boulders, that it affords a splendid agricultural soil. In some places, however, the clay will prove to be rather fat or strong to be of much use in agriculture. Such clay is found in the low swampy areas already mentioned. These will be avoided because of their wet character, so that it may be said that the area as a whole is admirably suited for farming, an industry which will no doubt give a great future to this and a much extended area to the west and southwest, in northern Ontario. The exploration surveys made in 1900 show that there are some sixteen million acres in northern Ontario which does not differ materially from the area under discussion. The timber is principally pulpwood, the trees being balsam, spruce, poplar and birch. Small clearings around the Hudson's Bay Company's posts and more particularly along the right of way of the Transcontinental railway have shown that the soil will grow practically anything that can be grown in the agricultural parts of older Ontario.

The various resident engineers of the Transcontinental have made numerous experiments not only with cereals, but with vegetables, and almost every vegetable that has been tried has grown well; even tomatoes have been ripened on the vines, while oats, wheat, barley, and excellent hay have been grown about the stables at these camps.

[3] 14th Rep. B. of M., 1905, Part I., p. 185.

## Gold

Gold was reported as occurring in lake Abitibi by Mr. R. W. Coulthard, in his report in the Exploration Survey of Northern Ontario in 1900, where assays of $1.40 a ton are given. The area did not attract attention, however, till 1906, when the rush of prospectors to northern Ontario, induced by the Cobalt boom, carried many of them farther afield, some following the water routes as far as Abitibi. During the summers of 1906 and 1907 every rock outcrop on the shores of this lake or on islands was staked as a "discovery of valuable mineral." Regarding this movement Dr. W. G. Miller, writes:[4]

"There are three areas in northeastern Ontario which have attracted the attention of prospectors for gold during the last two seasons. These are Larder lake, Abitibi lakes, and Nighthawk lake . . . . The deposits on the shores and islands of the Lower and Upper Abitibi lakes visited by the writer in August last are different from those described by Professor Brock and Mr. Cole on Larder and Nighthawk lakes respectively. The chief point of resemblance is that the same green mineral is found in some of the deposits at Abitibi as that in the deposits of the other two lakes. Mosher Bros. and others did considerable prospecting on the Abitibi

Stringers of quartz in dolomite.

lakes in 1906. During last winter a shaft seventy-five feet in depth was sunk on a vein on a small island, which lies five or six miles north of the north end of the narrows which connect Lower Abitibi lake with the Upper Abitibi lake. The work on this vein in Lower Abitibi lake is the most systematic which has thus far been done on any of the deposits in the vicinity of the lakes. A little work has been done on a deposit in the south bay of the same lake and at a few points elsewhere."

With the discovery of gold by Mosher Bros. a rush took place to this lake. Hundreds of claims were staked out, many of which disappeared with the melting of the ice in the spring, because more than one claim was staked in snow and ice on the lake, and when the ice melted both the stake and "claim" disappeared. This is but one evidence of the indiscriminate staking that goes on when a rush of prospectors takes place to any area.

In further description of the one good find made by Mosher Bros., Dr. Miller, referring to a little island known as Shaft island,, numbered B.C. 173, on which the mining was done, says:

"The auriferous quartz vein on Shaft island varies in width from about four feet to a few inches. It has a vertical dip with strike east and west, and cuts a massive igneous

[4] 16th Rep. B. of M., Part I., p. 219.

rock which may be called diabase. This rock has a somewhat fresh appearance and seems to belong to the newer series of eruptives, similar to that of the post-Middle Huronian diabase of the Cobalt area. This Abitibi diabase, like that of Cobalt, carries quartz as a characteristic constituent. Iron pyrites together with a little copper pyrites and a dark colored zincblende occur in the quartz vein. Fine gold is frequently visible in the quartz. The vein cuts across the island for a distance of over two hundred feet, and disappears into the water on both shores."

To the above description I would add but little. The diabase is here in contact with Keewatin greenstones. In many places it contains inclusions of the Keewatin, which clearly shows that it is later in age. Examined microscopically, the diabase from lake Abitibi shows no differences as compared with the same rock from the Cobalt area. The quartz vein mentioned already as cutting across island 173 reappears on island No. 106 which lies to the southwest. In addition to the minerals already mentioned as occurring in this vein, some pyrrhotite and calcite were found. The quartz is quite sugary in character, and is well banded in many places, showing the distinctive characteristics of a fissure vein. It is quite strongly mineralized with iron pyrites

On Shaft island.

and chalcopyrite. Cutting the diabase, and therefore sufficiently later to represent at least the end action of the intrusion, is a series of aplitic and also lamprophyric or dark colored dikes. But the vein cuts these just as freely as it does the diabase, proving that the vein must have been formed even later than they. At the south end of Shaft island the Keewatin greenstone is in place.

The equipment on this property is quite complete, and consists of sleep-camps and assay office, with blacksmith shops, steam-hoisting plant, steam-drills, a twenty horse power boiler, and good pumps. The value of the ore too, is quite high, but the ore body is small. As already mentioned, it varies from four inches to four feet, changes in width being quite abrupt. The ore would need to be rich to form a producing property.

In Dr. Miller's description above cited he mentioned a second type of gold deposit from lake Abitibi in the following words[5]:

"The types of gold deposit seen on the Abitibi lakes by the writer are essentially of two kinds: (1) that of Shaft island in Lower lake Abitibi; (2) those of the south shore and the islands of Upper Lake Abitibi. . . . . The half dozen deposits examined occur in rock of Keewatin age. These rocks here consist essentially of

[5] 16th Rep. B. of M., Part I., pp. 219, 220.

green schists, which are cut by dikes of fine grained granite or porphyry, varying in width from a few inches to fifteen feet or more. They have been shattered, narrow cracks running across them, characteristically transversely from wall to wall. These cracks are filled with quartz, and there are also at times lenses and irregular masses of quartz, replacing the dike material, or enclosed between it and the wall rock. Fragments of the dikes are frequently cemented by quartz, thus forming a breccia. The dike material is at times changed to sericite schist. The dikes have been impregnated with iron pyrites which is now altered. to a considerable extent, to iron oxide. The pyrites appears to be the gold-bearer. Colors can be obtained by panning the dikes, but the highest fire assay from samples taken by us gave only $3.40 per ton. Copper pyrites is at times associated with the iron pyrites."

To this description I would only add that these veins are for the most part merely stringers, and unless one found many of them closely associated so that the whole mass could be worked, they would be of little worth owing to their low content of gold. A series of assays made from picked samples gave in no case higher than $4.00 per ton, which is a low value even in a large deposit of ore. To the above two types of gold-bearing veins I would add two others. First, quartz veins in Laurentian granite; second, quartz veins and small quartz stringers in a rusty weathering dolomitic rock of Keewatin age.

On the west shore of what is known as South bay (a glance at the map accompanying this Report will show the position) and near the point marked 48 A, in an exposure of pink hornblendic granite of Laurentian age, there is a vein of quartz, varying from five inches to two feet in width. This vein carries considerable iron pyrites and copper pyrites. It has been staked and developed to some extent by Mosher Bros. A shaft about thirteen feet deep has been sunk and machinery has been brought to the property, but not yet erected. A good camp has been built, together with stables and blacksmith shop. This quartz vein is enclosed entirely in Laurentian granite, and there is no other rock in the immediate vicinity of the property. A picked sample of the ore assayed $4.00 to the ton. This, however, is too low a value for so small a vein to be of economic importance.

The second type of deposit is that of quartz veins and stringers in the so-called rusty weathering dolomite. This type of occurrence has been already described by Prof. R. W. Brock in his report on Larder Lake where he writes as follows[6]:

"The most interesting rock from an economic standpoint near Larder Lake is The rusty weathering dolomite (?) About sixty per cent. of the rock consists of lime-magnesia-iron carbonate, the remainder of quartz and a soft green talcose silicate, probably serpentine. The origin of the rock is as yet a little uncertain. Certain dikes, when squeezed and altered, produce a rock which bears a strong resemblance to it, but its occurrence with slates and phyllites and with the cherts—undoubted sedimentary rocks—as a conformable band with them, over a wide stretch of country, and its apparent composition, render it much more probable that it is an altered, stratified, ferriferous dolomite, probably forming a member of the Iron formation. This rock especially where cut by the porphyry or pegmatite . . . . is traversed by innumerable stringers of quartz which in places are gold-bearing."

The occurrence at Abitibi is on the point numbered 16 A along the east shore of the Lower lake. It is held by the Big Pete Mining Company. The description given by Prof. Brock and quoted above, applies so exactly to the deposit at 16 A, Lake Abitibi, that little need be added. Here the dolomite is also cut by a porphyritic dike as mentioned by Prof. Brock, and small stringers of quartz cut both the dike and the schistose dolomite. In a few cases the stringers extend from one formation across the contact into the other, but more often the stringers, whether in the dike or in the schistose dolomite, are cut off at the line of contact, and do not extend into the

[6] 16th Rep. B. M., Part I., p. 207.

adjoining formation. (See illustration.) An assay of this deposit showed less than $1 to the ton, and it would not appear that this occurrence is of economic value.

Immediately south of this claim are three others, held by the same company. On these are quartz stringers, which cut the Keewatin. A little development work in the shape of a shaft and open cuts had been done at the time of our visit, and a diamond drill was in process of erection on the property, by which the veins were to be tested at depth. What the results of this work are I have been unable to learn, but assays of picked samples from the shafts and open cut work were not very promising. The veins were quite large and highly mineralized with iron and copper sulphides, and with pyrrhotite, and assays of this material showed traces of gold, but not in economic quantity.

From the foregoing descriptions it will be seen than gold-bearing quartz-veins found in the Abitibi area occur in rocks of three ages, namely, (1) quartz-veins, and small stringers in the Keewatin greenstones, in some cases following the schistosity, and in others cutting across it; (2), quartz-veins and stringers in the Keewatin rusty-

Quartz stringers in rusty-weathering dolomite dying out at contact line.

weathering dolomites; (3), quartz-veins in Laurentian granite; (4), quartz-veins in the post-Middle-Huronian diabase. This latter type is the most productive in the Abitibi area.

### Geology

A glance at the map accompanying this Report will show that, aside from the unconsolidated post-Cainozoic deposits, the rocks of the area are of three ages, namely, the Keewatin, the Laurentian, and the post-Middle Huronian. It is not my intention to follow the outlines of these areas in detail. It is scarcely necessary to mention that the outcrops of the various formations are by no means as continuous as shown on the map, but it was thought advisable to make the distribution as complete as the many outcrops would suggest, so as to give a map of use to prospectors and others who would not possess the technical knowledge necessary to supplement an incomplete map showing only the actual outcrops. Moreover, the heavy burden of glacial drift covering this area makes it impossible to actually trace the various contacts, and they have been put in approximately by connecting the outcrops of like formations, governed somewhat by the topographical features as well.

A study of the texture of the rocks of the district, their structural relationships in the field, and their relative ages as denoted by contacts, divides them into the following ages in descending order:

| Name. | Rocks. |
|---|---|
| POST-GLACIAL | Clays, sands, gravels, peat and marl. |
| GLACIAL | Saugeen clay, Boulder clay. |
| POST-MIDDLE HURONIAN | Quartz-diabase—Quartz-gabbro—Lamprophyric and aplitic dikes. |
| LAURENTIAN | Granites, pegmatites granite porphyry. |
| KEEWATIN | An igneous complex composed of schistose greenstones together with porphyries and various other more or less metamorphosed representatives of essentially volcanic rocks. Infolded with this igneous complex is a sedimentary series consisting of dolomites, usually rusty-weathering, graphitic slates, jaspilites and fragmental material |

### Keewatin

As in other districts where the Keewatin is widely distributed, it presents in the Abitibi area an almost endless variety of phases. Chief amongst these is ellipsoidal structure, highly developed, particularly on the weathered surface. I have never seen this so common as in the Keewatin rocks on the south shore of Upper lake Abitibi. Another of the characteristics is the abundant development of hornblende schists, with wavy foliations of the bands. Reference to the map will show that the Keewatin is very widely distributed in this area. On the Upper lake, for example, it forms the south shore from end to end, and extends inland as far as we were able to proceed. It is also very widely developed on the north shore of the Lower lake and down the Abitibi river.

The Keewatin presents the usual wide variation shown by this series in other places. It seems on the whole to resemble most closely the same formation in the Larder Lake area, and almost every word written by Prof. Brock concerning the Keewatin formation in Larder lake, would be equally applicable here. Possibly the commonest type in the Keewatin is the typical green chlorite schist, but the black hornblende schists are also very abundant.

On the east shore of the lake the slow process by which the formation of hornblende schist has occurred, is clearly shown. Just north of point 31 A there is a contact of granite with a light colored phanerite. This rock consists of hornblende with feldspar, which when examined with a microscope is seen to be almost entirely plagioclase, and the rock could be very properly classed as an acidic diorite. As we proceed north along the shore, however, it changes, quite gradually. At first it becomes gneissoid, but this structure soon gives way to a schistose phase and finally in the vicinity of the Aylen river, it passes into a perfect amphibolite schist, which shows in many places by the peculiar twists and foliations, that it owes its origin to a shearing and metamorphism of the above described diorite.

That this series is undoubtedly older than the Laurentian is shown by the fact that at the contacts the Laurentian cuts it and includes fragments of it. In one place, several fragments broken off from the adjoining hornblende diorite are included in a granite dike, and the places from which they had broken are easily seen. These fragments exhibit the same structure, composition, and gneissoid character of the surrounding rock, showing clearly that the Keewatin at this particular point had become gneissoid before the intrusion of the granite. This would imply an appreciable period between the formation of the diorite and the intrusion of the Laurentian granite, since sufficient time must have elapsed to allow the Keewatin to take on a gneissoid structure. Other evidence will be given later to show that the Laurentian did not follow immediately on the igneous Keewatin, but that there was a lapse of time between the formation of much of the Keewatin and the intrusion of the Laurentian into it.

**Chrome Iron Ore in Keewatin**

About the middle of the east shore of Northeast bay in Lower Lake Abitibi, just south of point 16 A., and associated closely with the hornblende schistose series already described, is a strongly magnetic rock, which at first sight appears to be a very basic dike. Upon collecting samples of it, however, and examining these upon my return, I found that the rock possessed all the appearances of an altered peridotite. Large crystals of olivine had apparently altered completely to a secondary fibrous mineral, which appeared to be unmistakedly serpentine. Scattered through the rock was a black oxide of iron, which suggested the possible presence of chromite, in that the rock as a whole resembled typical dunites. Under the microscope the rock appeared to be composed of about three-fourths fibrous serpentine, pseudomorph after olivine Scarcely a vestige of olivine is left. In some cases the serpentine fibres extended almost across the space originally occupied by the olivine. In other cases they seem to have formed at right angles to cracks or to project inward from the periphery.

The black oxide of iron occurs both in distinct crystals and in irregular grains, and in bands outlining the original olivine crystals, sometimes also in streaks amongst the fibres of serpentine, as if along cleavage cracks of the olivine. Filling the spaces between the pseudomorphs, and to some extent mixed with its fibres, is a small percentage of a colorless mineral with bright interference colors, which suggested calcite, but on later chemical analysis the scarcity of lime indicated that the mineral is probably magnesite. Other minerals present in the rock, are talc in small flakes and veinlets, hematite in reddish particles, and chlorite scattered indiscriminately through the section.

Chrome-bearing rocks have been known in the Lake Abitibi area, or reported at least from there as early as 1873. In his report of that year[7] Mr. Walter McOuat, gives the following description of an occurrence:

"Off a prominent point about the middle of the west side of the Lower lake there is a small island not more than six or eight chains long, which is composed of a dark green, rather soft rock with splintery fracture, and resinous lustre and weathering a dull white. It is so strongly magnetic that our compasses were found to be quite useless on this island. This rock proved to be serpentine . . . . and was found to contain chromic iron."

A search of this shore by our party during the last summer failed to locate such an occurrence. We did find, however, an island in this position which contained the typical Keewatin Iron formation, to be described later, but no such occurrence as is reported by Mr. McOuat could be found.

Referring to the deposit directly east of the Iron formation, and already mentioned as occurring on the east side of the lake, a chemical analysis of samples of it shows the rock to be unique in its high percentage of chromic oxide. Suspecting for the reasons already given that this rock was an altered peridotite, I entrusted the analysis of it to Mr. H. T. White, B.A., a graduate student of the School of Mining, and had him make a special study of the rock during the past winter. The results of these analyses are here given with a comparison of several others, of similar rocks from various localities. Peridotites are characterized by the presence of chromic oxide, and with rare exceptions is it found to be less than 0.25 as a minimum and up to 3.55 as a maximum percentage. A series of twelve analyses given by Vogt all lie within this range, but this rock from Abitibi has no less than 6.72 per cent. of chromic oxide. Further than this, it carries a percentage of 14.13 per cent. of other iron oxides, so that it stands in great contrast with the others in this regard. A complete analysis

[7] Rep. C. G. S., 1872-3.

of the rock, however, as given below, will show that in other respects it is practically identical with the peridotite family as a whole, particularly the sub-group dunites.

| —— | I. | II. | III. | IV. | V. | VI. |
|---|---|---|---|---|---|---|
| $SiO_2$ | 35.05 | 34.59 | 41.89 | 44.99 | 40.11 | 40.18 |
| $Al_2O_3$ | .73 | 2.39 | trace | 5.91 | .88 | 1.35 |
| $Cr_2O_3$ | 6.72 | .38 | .58 | .25 | .18 | 1.41 |
| $Fe_2O_3$ | 9.05 | trace | trace | 3.42 | 1.20 | 10.97 |
| FeO | 5.08 | 8.66 | 7.39 | 8.30 | 6.09 | ........... |
| CaO | .54 | 3.62 | .06 | 8.79 | .11 | ........... |
| $K_2O$. $Na_2O$ | ........... | ........... | .82 | 1.65 | ........... | ........... |
| MgO | 33.09 | 32.25 | 49.13 | 21.02 | 48.58 | 43.84 |
| $CO_2$ | 1.54 | ........... | ........... | ........... | ........... | ........... |
| $H_2O$ | 8.47 | 17.52 | .35 | 3.82 | 2.74 | 2.01 |
| | 100.27 | 99 41 | 99.12 | 98.15 | 99.99 | 99.76 |

I. Peridotite from Lake Abitibi.

II. Peridotite from Pigeon lake, Montreal river. (C. G. Sur. 1876-77 p. 843.)

III. Peridotite, variety dunite, from North Carolina. (N. C. G. S. 1905.)

IV. Peridotite from Michigan.

V. Peridotite from North Carolina.

VI. Dunite from North Carolina.

It will be seen aside from the specimens from lake Abitibi, that the highest percentage of chromic oxide is 1.41, and this is the highest found in a number of analyses. The peridotites from Maryland, for example, seldom show over 0.5 per cent. of chromic oxide. The specimen from Abitibi running 6.72 per cent. is therefore exceptional. The part of the intrusion from which the sample is taken, however, has often much to do with the percentage of $Cr_2O_3$, which shows a tendency to segregate near the contact of surrounding rocks. Chromite almost always occurs associated with serpentine, which has resulted from the decomposition of such basic rocks as contain olivine, hornblende, or pyroxene in abundance. This does not mean, however, that the chromite is necessarily a secondary product. While chromite is often produced in the alteration of these basic minerals, much more of it is original in the rock magmas, from which these basic rocks crystallize, just as magnetite is found in gabbroic magmas as an original constituent. According to Pratt (A. I. M. E. February, 1899), chromite is concentrated by being the first mineral to crystallize out, and gets close to the walls of surrounding rocks, or is carried in bands near to these rocks as a result of convection currents, so that when prospecting for chromite one should search near the border of peridotite masses, that is near, or at, its contact with surrounding walls. In this way may occur isolated pockets or bunches of ore, not connected with each other, or with the internal mass. If then, the sample be taken from such an occurrence it will assay higher in chromite than usual. In the case of this rock, however, as I have already mentioned, I did not suspect it to be peridotite, nor was I aware of the presence of chromium until making a laboratory examination of the material collected, and I feel safe in saying that this particular specimen was a representative one of the rock outcrop.

The outcrop was not over sixty feet in width, and probably 250 feet in length, although it may have much greater dimensions than these, and as its economic bearing was not suspected, it was not given detailed examination by our party during the past summer. The existence of such chrome-bearing rocks in Ontario may well encourage us to investigate them a little further. As has been already mentioned, all deposits of chrome iron ore have this same association, but other minerals of greater value are also found associated with the same rocks. The valuable deposits of asbestos found in Quebec are in this class of rocks, and I may add that since returning from the north, a specimen has been sent to me by a member of one of the Transcontinental

survey parties, as having been found in that district, which does carry a little vein of asbestos over half an inch wide.

In addition to asbestos and chromite, the valuable deposits of platinum in Russia, are in similar peridotite rocks. Platinum has also been found amongst the alluvial collections of the Chaudiere river, and is believed to have been formed from the peridotite rocks of Quebec, although the platinum has not been found in place. Platinum has also been found in peridotite rocks in the Similkameen district of British Columbia.

Furthermore, the corundum deposits of North Carolina all occur in these peridotite rocks. Consequently, having shown the presence of peridotite amongst our Keewatin series of Northern Ontario, it would be well for prospectors to keep these points in mind, and in searching for the more valuable minerals not to overlook these highly economic deposits of a different kind. From the explanation and sketch given above we can readily understand the apparently unconnected pockets from which stringers often run off; the widening and the pinching out of pockets; the grading of good chrome ore into the barren country rock, etc. Experience has shown, that in looking

Jaspilite on Abitibi.

for chromite, the prospector should confine his energies to a search of the contact or at least near the contact of peridotite or serpentine masses with the surrounding rocks, and he should always keep in mind the possibility of any or all of these other economic products so commonly associated with the peridotites.

On account of the irregularity and disconnected character of the chromite ore bodies and the smallness of not a few of them, mining this ore has always been rather hazardous. Any fair-sized body of ore, however, if favorably situated as regards transportation, should warrant exploitation on account of the possibilities of the presence of one or more of these valuable by-products. Chromic oxide, itself, should be as high as 50 per cent. to make the ore valuable, and every per cent. over this is bonused by buyers, but every per cent. below is penalized. Just now, the attention of prospectors and mining men generally is so much concentrated on the silver and gold ores of Ontario that the base metals are being neglected.

#### Keewatin Sediments

In addition to the great volume of chloritic and hornblendic schists and the great variety of Typical Keewatin greenstones, we find at lake Abitibi another series of Keewatin rocks that are extremely interesting and, as yet, puzzling. They consist

of a fragmental series made up of graphitic slates, cherty bands, and a coarse fragmental series, the fragments of which show distinctly on weathered surfaces, and from their shape give apparently evidences of water action. This series is very closely associated with the rusty weathering dolomite in some places, and in other places with the typical Keewatin jasper-magnetite series, like that of the Lake Superior region.

About the middle of the west shore of Lower lake Abitibi on island No. 14, and on the mainland immediately north of that, are two outcrops of the jaspilite Iron formation. The formation here is very much tilted and folded as shown by the illustration. The dip of the formation is practically vertical and the strike is 23° north of east. This is the general strike of a whole series of fragmental rocks which are found at the northerly side of this Lower lake, and will be described hereafter. The Iron formation consists of alternate bands of magnetite with silica, and is the typical Lake Superior sedimentary Iron formation which has been described by Van Hise, Leith, Bayley and others. It is similar in character to the Iron formation found in Ontario in the Temagami area, Boston township, Hutton township, and the district east of lake Nipigon. In discussing this latter area Dr. Coleman states[8]:

"The Iron formation is the highest or almost the highest part of the Keewatin .The materials of the Iron formation in the Nipigon region are always silica in some form, and an oxide of iron, magnetite or hematite, never siderite, nor sulphides, as in the Michipicoton region. There are two types of the formation, one consisting of interbanded quartzitic or cherty silica, with magnetite; the other of jasper with hematite, but there are mixtures of the two varieties in many places."

The occurrence on lake Abitibi is of the first type, viz., interbanded quartzite with magnetite. In describing the occurrence of peridotite above, I mentioned a reference by Mr. McOuat to an occurrence of iron ore near the west side of this lake, and suggested that possibly the outcrop on this island was the one referred to by him. The magnetite at least is so abundant here as to affect the compass very seriously. An analysis of the ore, however, failed to reveal any chromic oxide, so that it is quite possible that some other location is covered by his description.

This jaspilite Iron formation, as in other places, is not yet possible as an iron ore, for the percentage of iron scarcely ever exceeds 38 and without further concentration it cannot be used. Moreover, the outcrop is only about 60 feet in width; the length could not be determined. A heavy covering of soil prevented tracing it on the shore itself, and an excursion up the Dokis river, which crosses the strike of this formation, failed to show any exposure of it. To the east on other islands it was not to be seen. Its chief interest therefore lies in its association with the rusty-weathering dolomite and other sedimentary rocks whose description will follow, and helps to confirm the opinion that not only is the Keewatin made up of igneous greenstones, and their metamorphic representatives, but also a series of sedimentary rocks, many of which may prove to be ordinary sediments and chemical precipitates. The association on this same island of the Iron formation with a small exposure of what appears to be the rusty-weathering dolomite further helps to confirm the opinion that this latter rock is a metamorphosed limestone of pre-Laurentian age, and coincides in age relationship, as well as in general association, with the Grenville limestones, described by Dr. W. G. Miller, in the eastern part of Ontario.

Not only are there jaspilite sediments, and the dolomite limestone closely associated, but a third series of fragmental rocks is also found, that look in every way like a series of squeezed and sheared conglomerates, whose pebbles are compressed and drawn out parallel to the general schistosity of the series, striking about N. 67° E.

Many of the fragments are distinctly seen to be of volcanic rocks, and none of them are granite. Whether these fragments represent squeezed and altered breccias,

[8] 17th Rep. B. of M., p. 143.

or whether they are water-worn fragments of a previously existing volcanic series is difficult to say.

That this series is older than the Laurentian granite, is shown by the following facts: (1) The granite, pegmatite, and granite porphyry dikes cut this series, as shown about points 19 A and 21 A. (2) It is free from granite pebbles, or granite fragments, although containing many easily recognizable Keewatin greenstone fragments. The lack of these granite pebbles cannot be attributed to a scarcity of this formation in the district, for as the map shows, it is very abundant. (3) Many of these fragments are enclosed in the granite dikes and pegmatites, for example at 21 A. (4) In many places the Laurentian series cuts it. (5) In many cases it is completely metamorphosed to a schist, which resembles in every way the typical Keewatin schists, and its origin is completely concealed unless indicated by its surroundings. (6) It is in many cases intimately associated with undoubted Keewatin rocks, many of which show the typical ellipsoidal structure on exposed surfaces. (7) On Island No. 113 this fragmental series contains recognizable pieces of the adjoining Keewatin which show spheroidal structure. (8) In some places very highly metamorphosed, this rock grades imperceptibly into typical Keewatin with its torsion cracks and its compact fine-grained uniform texture.

On the other hand, it is evidently younger than much of the Keewatin, for it shows many fragments of these rocks. Certain fragments, for example, show clearly that they are from an andesite porphyry. This is particularly well seen, by a microscopic study. The ground mass of the porphyry shows a feldspathic fine-grained character, with much chlorite and calcite, and scattered through this, are distinct phenocrys of feldspar. They are much decomposed now to saussurite, but the shape of the original crystals is well preserved, and in many places even the albite twinning can still be seen distinctly. The rock, therefore, contains fragments of an original andesite porphyry, which represents pieces of the old Keewatin volcanic series. The fragments show in many places a sheared and drawn-out character, producing a laminated gneissoid structure and pass imperceptibly into typical Keewatin schists, whose origin could not be decided except from their association with the fragmental material.

I have already mentioned the close association of these rocks with the jasper-magnetite series. It has been shown above that in the case of the Keewatin hornblende schists there was sufficient lapse of time between the formation of the original Keewatin diorite and the intrusion of the Laurentian granite, to allow the diorite to take on a gneissoid structure.

Concerning the possibility of a fragmental series of pre-Laurentian age in this part of Ontario, Dr. Miller, has said[9]:

"In two or three instances pebbles in the Lower Huronian appeared to be conglomerate, that is, they seemed to indicate that there had been a conglomerate series before the Lower Huronian was laid down. It would appear, however, that these pebbles and boulders come from the pseudo-conglomerates, namely, Keewatin dikes, which hold partly dissolved rounded fragments of rocks through which they have cut. . . . It is well however, to consider the possibility of a fragmental series in this district older than what is here called the Lower Huronian. The Keewatin undoubtedly contains some sedimentary material, shown by the jasper-magnetite bands. The writer believes that these sedimentary bands should be classed with the Grenville series, which is found in much greater volume in southeastern Ontario. He would place the Grenville sedimentary series between the Keewatin and Lower Huronian in age."

Again in his report on Larder Lake, Prof. Brock says[10]:

"The Keewatin rocks form the oldest and most disturbed formation at present recognized. These rocks were formed during a very extended portion of geological time, and under changing geological conditions. It is more than probable that this series should be subdivided into several formations, for some of the rocks are very

[9] 16th Rep. B. of M., Part II., pp. 48, 49.

[10] 16th Rep. B. of M., Part I., p. 208.

much newer than others, and have been subjected to much less alteration. Some disturbed and squeezed conglomerates intimately related to the Keewatin . . . . seem to belong to this formation, and if so, mark unconformities which might be utilized to subdivide the Keewatin. The subdivision is rendered difficult however, by the degree of metamorphism, and the disturbances through igneous intrusions. . . . A long time interval elapsed between the Keewatin and Lower Huronian, during which the Keewatin was a land surface subjected to heavy erosion. This erosion produced a topography not unlike that of this country at the present day. . . . Erosion and transportation must then have greatly exceeded atmospheric weathering, for the Keewatin surfaces and hills were swept bare of rotted rock, before the Huronian was deposited on them."

About four miles up the Low Bush river, which enters at the northwest part of Lower Lake Abitibi, is another rock which may be possibly connected with the highly metamorphosed fragmental series. On Lot 6 in Concession 4, of the township of Bowyer, there is an outcrop of micaceous schist, which has a rusty brown, weathered surface. This outcrop shows only in low water, being entirely covered most of the year by water and not being visible on either shore. The schist stands almost vertically with its upturned edges presenting a knife-like character. It strikes almost east and west, thus preserving the general strike of all this fragmental series. An examination under the microscope shows that the schist is made up of abundant brown flakes of mica, and granular quartz, all of which has become pressed into a typical quartz-mica-schist. Scattered abundantly through it, is untwinned staurolite, brown in color, and in fresh, well-defined crystals. The staurolite is filled with innumerable microscopic inclusions of quartz, but is perfectly fresh and unaltered itself. These small crystals of staurolite with their perfectly formed crystal faces are clearly seen under the microscope and also with the naked eye. The rock resembles perfectly, those staurolite schists so often produced from the alteration of argillaceous sandstones or other clay-holding sediments.

### Laurentian

The Laurentian in this district is represented almost entirely by hornblende granites, and in some places where quartz is practically absent the rock becomes a hornblende syenite. This series is intruded in the Keewatin, and is therefore later. Many good contacts can be seen both of the massive granite and of granitic, pegmatitic, or granite porphyry dikes, coming off from granite masses proper, and cutting the Keewatin, for example, along the shore of the Lower lake from point 17 A to 22 A, again along the shore from 28 A to 33 A, and again from 44 A to 47 A. On the north shore of the Upper lake, on the Quebec side of the boundary line, and on Mistaken island, many excellent contacts can be seen. Hence there is no possible doubt that this granitic series is later than the Keewatin. Moreover, it is cut in many places by fresh quartz diabase, the post-Middle Huronian, and is therefore older than these rocks. It is in every respect like the acidic intrusives called Laurentian by all authors. Good contacts of the later diabase cutting Laurentian granite can be seen about 44 A, 42 A and Islands 226, 227, 173 and 174. There is an enormous development of the Laurentian as shown by the accompanying map. It is nearly all hornblende granite, which shows on microscopic study a coarse-grained, hypidiomorphic mixture of common green hornblende, much altered feldspar, and abundant quartz. The feldspar has so completely altered on the surface to kaolin that pseudomorphs of kaolin after feldspar are very distinctly seen. This white kaolin together with the quartz in many places give the rock a very light color, so that narrow dikes of it are readily taken, at a short distance, for quartz veins, and all such are staked as discoveries of "valuable mineral in place" by the over-zealous prospector. The hornblende is often segregated, and is for the most part quite fresh. Some fibrous pieces resemble actinolite in character. In other pieces, however, the large characteristic prismatic angle of 124° is well marked. The hornblende is very abundant, but no biotite was seen either in the hand specimens, or in the rock sections examined under the micros-

cope. The quartz is in large distinct grains. It surrounds both the feldspar and the hornblende when in contact, and therefore crystallized last in the process of solidification.

The Laurentian granite forms the whole of the north shore of the Upper lake, and extends north as shown by the map to and beyond the Transcontinental railway, where several outcrops are seen and where rock cuts will have to be made. Just over the boundary line in the Province of Quebec, the formation changes, and the contact of the Laurentian with the Keewatin greenstone series is easily seen.

I have already called attention to a contact of the Laurentian with the Keewatin on Mistaken island, near the north shore at the entrance to the long bay which leads up to the Okikodosik river. An interesting point in connection with the granite is the gold-bearing quartz vein which was mentioned as occurring in it at point 48 A. This has been already described, and is only re-mentioned here because of occurring entirely in Laurentian granite away from any greenstone contacts.

The various dikes coming away from the granite and cutting the Keewatin greenstone present some interesting aspects. Many of them are beautifully porphyritic, The large phenocrysts of feldspar in a pink or gray groundmass are very characteristic, and afford some of the prettiest examples of granite porphyry that one could find. Accompanying the pegmatitic phases of these dikes, are the minerals iron pyrites, copper pyrites, pyrrhotite, and specularite. A good example of this can be seen south of the Big Pete mining claim near point 16 A. Here the quartz is so segregated as to produce what would easily be taken for a quartz vein. But a little search will show the presence of feldspars, which would show that this occurrence is more likely a dike. Moreover, this particular dike carries traces of gold on assay, hence the mistake of staking these for veins is easily made. A similar case is afforded by the so-called "white-dikes" of the Boundary district of British Columbia, which were long taken for quartz veins, and being actually gold-bearing, although in small amount, enticed the prospectors of that country to develop them at great expense of time and money, to no real purpose. Prof. Brock has called attention to the same character in the Laurentian pegmatite dikes of the Larder Lake area.

Since no Lower Huronian has been recognized in the Abitibi area, it is impossible to decide definitely whether the granite here called Laurentian is older than the Huronian or not.

#### Lower Huronian

The lower Huronian quartzites, slates and conglomerates, so abundantly present in the Cobalt and Larder Lake areas, do not occur about Lake Abitibi so far as could be determined. Certainly, no such conglomerates and quartzites as represent this age in the above mentioned districts are to be found here, and if any do occur, they are so profoundly metamorphosed as to be indistinguishable from the Keewatin. This does not seem likely, however, as the Lower Huronian conglomerate is so characteristic over a widespread area. In his report on Larder Lake, Prof. Brock has pointed out that although the Laurentian is represented there by dikes only, yet the Lower Huronian conglomerate is the typical granite-rich accumulation with which all are familiar who have seen this series in northern Ontario. I have already pointed out that granite of Laurentian age is very abundant at lake Abitibi and yet not a pebble of granite is to be found in the fragmental series of lake Abitibi already described. The typical granite-holding conglomerate of the Lower Huronian occurs abundantly as far north as Bourke's station on the Temiskaming and Northern Ontario railway, and within thirty miles of the area here described, but was not seen nearer. With the great development of granite about lake Abitibi, we would expect to find any later conglomerate filled with pieces of it, so I feel justified in saying that the Lower Huronian does not occur in this area, nor yet the Middle Huronian, the next formation above the Laurentian being the post-Middle Huronian diabase-gabbro series of intrusives.

#### Post-Middle Huronian

Cutting both the Keewatin greenstones and the fragmental series, and also the Laurentian granite series is a group of basic intrusives representing for the most part dioritic and gabbroic magmas. In the accompanying map the areal distribution is shown, and is relatively large. The rocks are, for the most part, quartz-diabase, in every way like those of the Cobalt area. In other places, however, the rock is very coarse-grained and presents all the phases of a typical gabbro, or in others a quartz-gabbro, which is a rather rare rock. In many places dikes of diabase come off from the larger main masses and form good contacts against the Keewatin or Laurentian series. In some cases there are a number of contact metamorphic minerals. For instance, about 26 A on the east shore of Lower lake Abitibi we have a first-class example. Here the intrusive series has disturbed the Keewatin greenstone very much, and many minerals the results of contact metamorphism have been formed. In a highly schistose groundmass, examples of actinolite, garnet, epidote, iron pyrites, and almost solid masses of hornblende are found along the contact. A narrow border, fine-grained in character, occurs along the edge of the dikes, while the diabase itself farther from the contact is quite coarsely crystalline or even pegmatitic in character. A microscopic examination of this diabase series shows that it is exactly like the intrusions of the same age in the Cobalt area, and the description of the rocks as given by Mr. C. W. Knight in the Bureau of Mines Report for 1907, page 60, would stand for this series. The diabase as well as the coarser gabbro-like series does not show, in hand specimens, anything of the ophitic texture, but under the microscope this structure is found to be present in both the fine-grained and coarse-grained rocks. The grain of the rock at any one locality is very uniform, and only occasionally, as in cases like that cited above, is there any marked variation in its characteristic coarseness.

The main point of interest in connection with this basic series is the presence of free silica, which is not at all a common thing in such basic intrusions. They are therefore quartz-diabases. A thin section will show plagioclase feldspar occurring in relatively narrow rods, almost always showing albite twinning lamellae. The extinction angles as well as the chemical analysis show that this feldspar belongs near the basic end of the series, or is practically labradorite. It is usually quite fresh even in surface pieces of the diabase.

A second mineral almost equal in importance is augite, a monoclinic pyroxene, in large distinct crystals. It is of a pale brownish color, and is pentrated by and in some cases actually surrounds the laths of feldspar. This mineral is abundantly present in both the diabase and gabbro-like series. Other minerals, quartz and a few grains of biotite, are sparingly present. Some usually occur. The biotite, however, is never a prominent constituent, and the quartz is usually present in micro-pegmatitic intergrowth with feldspar, although not always so.

In the case of the very coarse grained gabbro-like rocks, an examination under the microscope shows that the rock while originally made up of the same constituents as the diabase has suffered much by alteration. The plagioclase is in larger block-like crystals and is now almost all changed to saussurite. The augite has suffered change to uralite, a secondary hornblende, and about the only fresh constituent to be seen in this rock is the quartz, which is again in micro-pegmatite intergrowth with the feldspar as before. A few grains of magnetite and biotite are the only other fresh constituents. The shape of the crystals and the relation of the plagioclase to the augite is the same as that in the diabase, that is to say, the plagioclase crystals clearly formed before the augite, and therefore now penetrate it. This, then, is the same structure as found in the diabase and is called ophitic, so that we have not a gabbro, but a rock of gabbroic character possessing ophitic texture. Mr. Knight reports similar occurrences in the Cobalt area, page 63, Bureau of Mines Report 1907. It is very interesting to note how uniform is the character of this post-Middle Huronian intrusive series throughout its widespread distribution.

In the Temiskaming district it has been shown that the post-Middle Huronian series has a very intimate relation to the ore deposition both by fracturing the existing rocks, and by bringing the ore solutions themselves to the spaces so formed. In the Abitibi area, however, while the fracturing must also have taken place, there does not seem to have been the accompanying ore deposition. A great deal of prospecting had been done in this area previous to our visit, and an examination of all the claims staked, together with our own study of the formations, does not justify the expectation that there was any appreciable ore concentration accompanying the diabase intrusion. A series of twelve assays for gold and three for silver from the most likely looking veins, many of which showed mineralization in the shape of pyrites, failed to give more than a trace of gold, and no silver. The one exception to this statement has already been referred to as the Mosher vein, on Shaft island, No. 173. Here the vein is a typical fissure vein, filled with a gangue of quartz carrying free gold, and a few sulphides. It cuts the diabase, but it may, or may not have any genetic connection with this rock. I have already referred to another fissure vein which was also

Residual boulders from glacial deposits

gold-bearing, and which cuts Laurentian granite distant from a diabase contact. As yet we are not justified in claiming that the diabase intrusion, though the same as that for the Cobalt region, is associated with any appreciable ore deposition in the Abitibi area.

#### Glacial

In the Abitibi area there are no rocks younger than the post-Middle Huronian diabase except Glacial and recent deposits.

Resting directly on the polished and striated rock surfaces everywhere are great accumulations of glacial drift, or of sorted glacial drift. Many of the islands of the lake are made up of a clean polished rock base, on which is a heap of rounded boulders, washed entirely free from the finer material of the drift, so that now only a heap of coarse immovable boulders remain. All the finer material has been carried away to form banks of clay, of sand, or of gravel, which occur at various places about the shores. This condition is well shown in the illustration. The latest of the glacial accumulations is the Saugeen clay. This clay, which is a sorted and washed glacial clay, is made up of a series of interstratified bands of rich reddish brown clay, with bands of gray or greenish gray sand or shell marl. In some places, the bands are only

slightly calcareous, while at others the gray bands are almost entirely calcium carbonate. Regarding this clay Dr. Miller says[11]:

"The soil is essentially a well-banded clay . . . . Outcrops of solid rock, in many cases representing hill-tops which project through the clays, are seen. North of the height of land, however, is a large agricultural area estimated at sixteen million acres and known as the great clay belt, in which exposures of solid rock are few in number. The clay on both sides of the height of land is pretty uniform in character. . . . . It will be seen that the lime and magnesia are rather high. This is owing to the alternate bands containing considerable marl."

A full report of the general character of the Saugeen and other clays of Ontario, was prepared by me for the Bureau of Mines[12] in which a detailed description of this clay can be had by those desiring it. It is sufficient to add here, that this clay forms great banks about lake Abitibi, and these banks differ in no way from those described from other parts of Ontario, as given in the report mentioned above. In age I would place it as near the close of that Glacial period, for it appears to have been

On Abitibi waters.

formed from the flow and ebb about the edge of the retreating or melting glacier, and each two bands, that is a band of clay with a band of sand together represent the accumulation of one year. During the warmer or summer months, any increased flow of water from the edge of the glacier would carry the clay farther out, as well as the sand, while in the winter months, when the flow of water had lessened, a layer of clay and sand would be deposited nearer to the margin, and this process would be repeated year after year for many years, as shown by the great number of bands in the accumulation. The gradual recession in a northerly direction, as the ice front slowly retreated, would account for the great thickness of this clay. The few stones found in the clay, and they are very few, would be caused by small pieces of floating ice dropping imprisoned stones on melting. The presence of sand or marl as alternate thin bands with this clay renders the whole mass rather mild in character, and accounts for its loamy nature, making it valuable for agriculture.

The only formations occurring above the Saugeen clay are the recent accumulations of shell marl and peat, found so abundantly in the many land-locked lakes over this area. The great muskegs so prevalent in this north country, have been already

[11] 14th Rep. B. of M., Part II., pp. 26, 27.

[12] 15th Rep. B. of M., Part II.; Clay and the Clay Industry of Ontario.

mentioned in the earlier part of this report, and in these the accumulations of peat varying from two to fifteen feet have filled up the shallow lakes, the floors of which are Saugeen clay. In preparing the right of way for the Transcontinental railway many fine sections of peat underlain by marl and both of these underlain by Saugeen clay are to be found. In every case the Saugeen clay preserved the general characteristics already described.

This Saugeen clay really constitutes the chief resource of the Abitibi area, and one might add of the northern part of Ontario in general. As already pointed out, the close mixture of clay and sand so characteristic of this clay wherever found, renders it on exposure to the air a mild loamy soil, which will be eminently suitable for agricultural purposes. Some of the splendid farms near Barrie, Walkerton and Huntsville in older Ontario, as well as some of the newer ones about Englehart, and other clearings along the Temiskaming and Northern Ontario railway, show the great value of this soil for agricultural purposes. It has been already stated that the most of this north country is heavily covered by soil, so that its future will be an agricultural rather than a mining one. Vegetables and cereals of almost every kind have already been successfully grown in the small clearings about the "residencies" along the Transcontinental railway, and with further clearing of the timber and removal of the moss, the country will be much warmer, and its agricultural future assured.

There are many outcrops of rock about the shores and on the islands of these two lakes. They have been thoroughly prospected, but the mineral deposits, as already stated, are very small and for the most part extremely low grade. It does not appear, therefore, that this immediate area offers much inducement to the prospector. The region has been surveyed into townships. The excellent soil, and splendid transportation by water and rail should ensure a prosperous future for agriculture.

# LAKE OJIBWAY; LAST OF THE GREAT GLACIAL LAKES

By A P COLEMAN

## Introduction

Most of Canada east of the Rocky Mountains drains northward or northeastward in such a way that when the upper parts of the river valleys were set free by the retreating ice front toward the end of the Glacial period, the present outlets were still blocked, producing a series of great glacial lakes draining to the southward. The earliest of these lakes, covering large parts of Alberta between the front of the Keewatin ice and the Rockies, have been little studied and have not received names. The rich silty soil round Edmonton and southward towards Calgary was deposited on the bed of such lakes.

Later came lake Agassiz, hemmed in by the united fronts of the Keewatin and Labrador glaciers, with its outlet through the Red River valley into the Mississippi, the source of the fat clay soil of the Winnipeg region. This lake has been studied by Mr. Tyrrell and other Canadian geologists towards its northern limits, and has been mapped in Manitoba and the states to the south by Mr. Warren Upham.[1]

A southeastern bay of lake Agassiz extended into Ontario as far as Rainy lake, its silt deposits making the excellent farm lands of the Rainy River district.

After lake Agassiz was drained by the parting of the two great ice sheets, as melting progressed a very complex series of glacial lakes occupied in succession the basins of the present Great lakes. In Ontario they included lake Warren, the oldest and highest, lake Algonquin, covering most of the beds of the present lakes, and lake Iroquois occupying the Ontario basin.[2] The flat clays laid down on the bottom of these lakes furnish much of the best farming fruit growing land in Old Ontario.

The northern boundary of lake Algonquin was formed by the watershed toward Hudson bay, the Labrador ice sheet probably halting behind this barrier for a long time. At length the ice withdrew toward the northeast, and lake Algonquin probably extended a bay to the north of the watershed. A still farther retreat put an end to lake Algonquin by opening the Nipissing-Mattawa-Ottawa outlet, when the water sank to the Nipissing level, and the bay to the north of the watershed became a separate lake draining ultimately by the valley of the upper Ottawa and lake Temiskaming into the river fed by the Nipissing Great lakes, which must have been far larger than the present lower Ottawa.

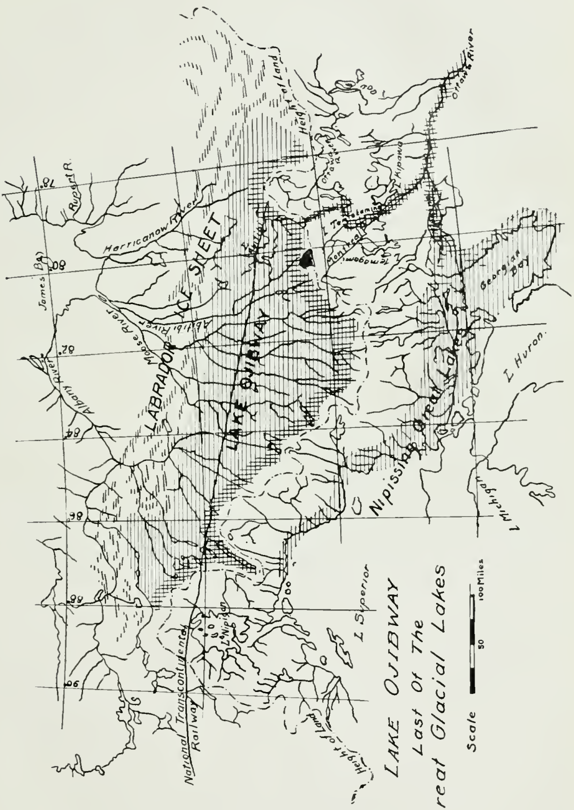
It is proposed to name this last ice-dammed body of water "Lake Ojibway" from the tribe of Indians sparsely scattered over the region it once occupied. Like all the other glacial lakes, this also deposited silt and clay of much practical value to the farmer, forming the "clay belt" of northern Ontario and Quebec, soon to be threaded by the National Transcontinental railway.

Though lake Ojibway has never been carefully mapped and its abandoned shores may not for a long time be known in detail, its general outlines have been pretty well determined by surveys and explorations in northern Ontario, mainly carried out by the Bureau of Mines; but its bounds within the Province of Quebec are less certain.

When the ice blocking the northward flowing rivers finally departed, lake Ojibway was drained, leaving as remnants the Abitibi lakes and many other smaller bodies of water in the clay belt. Probably only a few thousand years have elapsed since this last of the glacial lakes came to an end, and in many parts of its bed the drainage is still imperfect, leaving wide stretches of swamp and muskeg.

[1] U. S. Geol. Sur., Monograph XXV.

[2] 13th Rep. Bur. Mines, p. 225, etc.


LAKE OJIBWAY
Last Of The
Great Glacial Lakes
Scale
50
100 Miles
LABRADOR ICE SHEET
LAKE OJIBWAY
Nipissing Great Lakes
James Bay
Rupert R.
Harricanow River
Moose River
Abitibi River
Albany River
Height of Land
National Transcontinental Railway
L. Nipigon
L. Superior
L. Huron
L. Michigan
Georgian Bay
Ottawa River
L. Kipawa
Montreal
Temagami
78
80
82
84
86
88
90

### Lake Algonquin and Region North of Watershed

The last of the generally recognized glacial lakes is Algonquin, whose northern beaches have been more or less studied by Prof. Lawson[3], Dr.Spencer[4], Mr. Taylor[5], and the present writer[6]. Its northern shores along the Hudson Bay watershed have been greatly split up by differential elevation of the region toward the northeast, and range from about 1,000 to more than 1,400 feet above the sea in various places. No doubt a considerable part of the northeastward elevation occurred during the lifetime of lake Algonquin, which is thought to have been the most permanent of the glacial lakes.

It was long ago observed by Spencer and Taylor that the higher Algonquin beaches imply a water level considerably above certain cols or low passes crossing the watershed between the Great lakes and James bay: and it was thought at first that the whole region might have stood at sea level, so that the raised beaches were of marine origin. This view was soon given up, however, when Mr. F. B. Taylor, who has done such excellent work on these old water levels, proved that the beaches do not run north of the cols.

There are several of these low passes between the basins of the Great lakes and the Hudson Bay slopes; and these may be taken up from west to east, since they were probably set free in this order as the ice front shifted toward the northeast.

The most westerly col of which much is known is at the headwaters of Red Paint river, northeast of lake Nipigon. Railway levels give this divide an elevation of 1,046 feet above the sea. As terraces of lake Algonquin 20 miles to the south reach 1,100 feet it is evident that its waters would have crossed the divide at this point if there had been no barrier. The actual divide is occupied by extensive morainic deposits with many kettle-shaped basins partly occupied by small lakes. These basins were probably formed by the thawing of buried masses of ice, proof that the ice front then stood at the divide.

The next col which has been studied lies between Jackfish on lake Superior and Long lake, where the watershed takes an extraordinary bend southwards, reaching a point only 22 miles from lake Superior. As determined by aneroid the divide between Black river, flowing into lake Superior, and Long lake is about 1,040, considerably below terraces of lake Algonquin to the north and east. The divide and the shores of Long lake itself, 1,013 feet above sea, show indistinct beach deposits, so that one may conclude that the ice which occupied the col during the earlier stages of lake Algonquin left this basin as a long narrow bay at a later period.

Beaches suoh as would be formed in a great lake like Algonquin are lacking on the divide between Long lake and the headwaters of Pic river, where the elevation is only 1,018 feet; though moraines, kames and eskers occur, evidently the combined work of glacier ice and water.

The Missinaibi col, between the headwaters of that river flowing into Hudson bay and Dog lake belonging to the Lake Superior drainage, was the first to attract attention because of its position close to the Canadian Pacific railway. Mr. Taylor examined it years ago, expecting to find sea beaches or terraces crossing over toward Hudson bay, but failed to discover them and therefore came to the conclusion that the Algonquin water was a lake with ice filling the northward depressions and blocking the outlet towards the Ottawa valley. The elevation of the Missinaibi pass is about 1,090 feet, somewhat higher than those mentioned before; but there are beaches up to 1,330 or even 1,400 feet within 20 or 30 miles to the southwest, which would imply a broad strait not less than 240 feet deep, if the beaches were formed at sea level.

From Missinaibi southeastwards the watershed rises, reaching in places elevations of 1,400 or 1,500 feet; but old beaches, probably of lake Algonquin, are found here and

[3] Geol. Sur. Minn., 20th Ann. Rep., pp. 182, etc. [4] History of the Great Lakes, pp. 64, etc. [5] Am. Geol. Vol. XX, 1897, pp. 119-128; also Vol. XVIII, pp. 118, etc. [6] 14th Rep. Bur. Min., 1905, Part III., pp. 103-106.

there not much below the summit. Pardee on the Canadian Pacific railway has an elevation of 1,528 feet, and the watershed a little to the east reaches 1,538, the highest point recorded on this part of the railway. Chapleau, 14 miles farther east, is on the Hudson Bay side of the watershed, and the small flat plain on which the village stands may be a terrace representing an extension of lake Algonquin beyond the divide at an elevation of 1,418 feet. Whether this terrace-like flat really belongs to the Algonquin beaches is however doubtful.

At Turnbull siding (1,390 feet) the railway turns to the southeast while the watershed goes on to the east at elevations not much lower so far as determined by aneroid.

Cartier, 80 miles southeast, is on a well formed gravel terrace at 1,381 feet, and similar lake deposits are found at Geneva lake a little to the west rising somewhat higher[7]. These were formerly thought to have been formed by lake Warren, but later work by American Pleistocene geologists makes it probable that they represent the highest levels of lake Algonquin.

Similar terraces rising above 1,300 feet reach from 40 to 50 miles north of Cartier at the headwaters of Spanish, Onaping and Wahnapitae rivers, and on Meteor lake, along the watershed. The elevation (by aneroid) of the Meteor Lake terraces is 1,420 feet. Here there are numerous kettle lakes and empty basins probably formed by the melting of buried ice blocks at the margin of the retreating Labrador sheet, similar to those found along other parts of the divide.

Beyond Meteor lake the watershed trends northeast and sinks to lower levels, reaching only 1,050 feet where crossed by the Temiskaming and Northern Ontario railway, once more rises for a distance, and then sinks to about 930 feet between the headwaters of Ottawa river and lake Abitibi.

Still farther to the east, in the Province of Quebec, the elevation of the watershed rises again, so that the lowest point is where the northward extension of the Temiskaming valley joints the depression of lake Abitibi.

Characteristic terraces extend along the southeast side of the divide from the point where it bends northward, and also stretch along the northwestern side at corresponding levels, conclusive evidence that here at its eastern end the ice had withdrawn far enough to permit lake Algonquin to pass the summit and occupy part of the Hudson Bay slope. For example, beginning at the Meteor Lake terraces (1,420) and going south along the Vermilion placers, sand and gravel plains occur at various levels, down to 1,047 feet, west of lake Wahnapitae. Going north from Meteor lake there are sand plains at various levels down to 1,100 near Mattagami post.

The highlands of the watershed formed therefore a somewhat broad peninsula stretching northeast.

There came a time when the Temiskaming, Ottawa and St. Lawrence valleys were abandoned by the ice, which had hitherto stretched all the way to the Thousand Island region, imprisoning lake Algonquin on the north and lake Iroquois on the south. These two glacial lakes were drained and the waters north of the divide sank by stages to the level of the Temiskaming outlet, giving rise to the separate lake, here named Ojibway.

Among these earlier outlets before the Temiskaming valley was freed from ice, the only one which has received much attention is that of the Vermilion placers, where gold bearing gravels may be followed southwards for 40 miles from the region of Meteor lake to an old bay of lake Algonquin[8].

[7] 14th Rep. Bur. Mines, 1905, part III., p. 103.

[8] 10th Rep. Bur. Mines, 1901, pp. 151-159.

### Deposits Formed in Lake Ojibway

From what has gone before it will be seen that sand and gravel beds were formed at various levels north of the Hudson Bay watershed as soon as the ice began to withdraw. As it was much thicker than elsewhere on the low ground between lakes Abitibi and Temiskaming, it was, no doubt, later in vanishing, and we may imagine various water levels resulting each lower than the last, until the final level at something over 930 feet was reached.

In the shallow water along the south shore of the lake coarser materials, gravel and sand, would accumulate, while in the deeper water silt and fine mud would be laid down; but since the position of the shore shifted northward as the lake was drained to lower levels, we should expect to find frequently the coarser sediments, sand, etc., overlying stratified clay. This is exactly what is found, and references have been made to these lake deposits by various geological explorers, though without giving the lake a name.

Broad stretches of clay have long been known from northern Ontario, having been noted as early as 1870, '71 and '72 by Dr. Bell[9] and Mr. McOuat[10], the latter referring briefly to the flat clay land north of lake Temiskaming and round lake Abitibi. Survey parties running base lines for the Crown Lands Department of Ontario have extended our knowledge of the clay and loam deposits between the river valleys. Mr. E. M. Burwash and Dr. Parks, accompanying such parties as geologists in 1896, '98 '99, and 1900, reported large areas of stratified clay, Dr. Parks calling attention to the fact that the belt of clay passes southward into sand.[11]

The sending out by the Department of Crown Lands in 1900 of ten exploring parties, each accompanied by a geological assistant, gave final proof of a wide expanse of good clay soil, mostly lake deposit, estimated to cover 15,680,000 acres or 24,500 square miles[12].

In 1901 my own work showed that lake gravels extend across the watershed and that sand flats descend northwards for 30 or 40 miles near lake Mattagami, etc.[13] Details in regard to the distribution of these lake deposits will be found in the reports referred to above, and it will not be necessary to mention more than a few of them.

### The Abitibi Region

The clay deposits at the north end of lake Temiskaming are pale gray or whitish and well laminated, evidently old lake deposits and rise, so far as I can discover the levels, to about 775 feet above sea near Haileybury, or about 200 feet above the present lake; while at North Cobalt there is a sand terrace at 865 feet. As noted by McOuat in 1872, these stratified clays extend north to the watershed, rising at least to 930 feet, and enclose the upper and lower Abitibi lakes, reaching about 30 feet above these bodies of water.[14] In some places between Temiskaming and Abitibi lakes, however, he finds the clay overlain by sand, and points of Archean rock project through it.

In 1896 Mr. Burwash, as geologist to Mr. Niven's base line survey party, found first sand (at mile 100) then sand above and clay beneath (to mile 109) with stratified clay about Night-hawk lake and to the end of mile 120. This region is about 40 miles southwest of Lower Abitibi lake. Going southeast of this toward Matachewan stratified sand and gravel were encountered, evidently shore deposits.[15]

Dr. Parks accompanied Mr. Niven on the northward extension of this meridian line, and describes stratified clay rising 40 or 50 feet above Night-hawk river, and

[9] Geol. Sur. Can., Vol. 1870-71, p. 350. [10] Ibid., Vol. 1872-3, p. 134. [11] 9th Rep. Bur. Mines, 1900, p. 142.
[12] Rep. of the Survey and Exploration of Northern Ontario, 1900. [13] 10th Rep. Bur. Mines, 1901, pp. 211, etc.
[14] G. S. C., 1872-3, pp. 133-4. [15] 6th Rep. Bur. Mines, 1896, pp. 177-183.

mentions stratified clay and sand at various points to the north.[16] In the following year he continued this work, and our knowledge of a considerable part of the southern boundary of the clay belt is due to his observations.

In 1904 Mr. G. F. Kay calls attention once more to the stratified materials, clay, sand, and gravel, in the Night-hawk Lake region, and referred them to glacial lakes, stating that "there is no doubt, however, judging from the wide distribution and heights of these stratified deposits that the lakes were of considerable extent. While the laminated clays were being laid down in the bottoms of these lakes, the sands and gravels were being deposited along the shores or near the margin of the ice sheet."[17] Mr. H. L. Kerr examined part of the region in greater detail two years later, and speaks of the stratified sand and clay as deposited in glacial lakes.[18] None of these writers, however, gave the old lake deposits any very careful study.

### Lake Deposits on the T. & N. O. Railway

During the past summer I had opportunity to visit a few localities along the line of the Ontario government railway where cuttings or river valleys give sections of the Pleistocene deposits. On the line between North Bay and Cobalt a number of terraces are to be seen, belonging probably to the Nipissing Great lakes. North of Cobalt the line rises to the Hudson Bay watershed at mile 178, and then descends to Matheson and Cochrane, the latter at the junction with the National Transcontinental railway some distance west of lake Abitibi and about midway in the clay belt as mapped by the Department of Crown Lands.

Going north from Cobalt, one encounters flat clay terraces at Haileybury, New Liskeard and Uno Park stations at levels that run from 642 to 776 feet, all probably belonging to the Nipissing Great lakes. The clay is beautifully stratified in thin layers of paler and darker materials, no doubt laid down in moderately deep water. Entirely similar clay occurs on the other side of lake Temiskaming near Ville Marie in Quebec. Good illustrations of the appearance of the New Liskeard clay are given in Prof. Miller's report on the Cobalt Region.[19] Red bricks are made from it near the station at New Liskeard. Bluish, well stratified clay is to be seen near Earlton also, in the bank of a creek, while at Heaslip and Englehart there are terraces of this clay at levels of 700 to 720 feet. Just south of Englehart there is a railway sandpit, showing 10 or 15 feet of stratified sand over clay.

Beyond this the grade rises rapidly, and no undoubted terraces or water levels were seen until Dane was reached, a point 1,034 feet above the sea, not far south of the watershed, according to the railway levels. Along this part of the line the underlying rock frequently rises above the drift, sometimes as hills hundreds of feet high with bare cliffs, while boulder clay is to be seen frequently in the valleys.

At Dane a railway gravel pit shows coarse kame materials rising to 1,060 or 1,070 feet, but growing finer and better stratified to the northwest, where the pit shows somewhat evenly bedded silt, sand, and gravel, apparently deposited in a lake and rising to about 1,050, the highest beach-like materials observed along the line. Beautifully stratified clay shows in the ditch just south of the temporary station at 1,034 feet.

Along the road to Larder lake 6 miles east of Dane there is a broad flat of stratified clay at about 1,020, undoubtedly a lake deposit; and a sand plain still farther east, six miles from Larder lake, at 1,070 or 1,080 feet is clearly water laid. Underlying the sand in stream valleys one sees well stratified silt and then clay. There are also patches of sandy and gravelly till in the lee of rocky projections, and near White river, two or three miles west of Larder lake, there is a kame, so that we have the usual mixture of morainic and water laid materials near the watershed.

[16] 8th Rep. Bur. Min., 1899, p. 175, etc. [17] 13th Rep. Bur. Min., 1904, Part I., p. 115. [18] 15th Rep. Bur. Min., 1906, Part I., p. 131, etc. [19] 16th Rep. Bur. Min., 1907, Part II., pp. 34-35.

Continuing north from Dane there are a few clay plains of small size, apparently lacustrine, but also areas of boulder clay and kame-like sand and gravel. North of mile 181 lake sand rises 10 feet above the track, and at Bourke's (mile 182) laminated clay with sand above may be seen rising to 1,040 feet, the waterlaid and ice-laid materials alternating.

Beyond the watershed at mile 183 flats of sand and clay, with boulder clay also here and there, occur all the way to Matheson (mile 205), where the typical plain of the clay belt begins at a level of 890 feet above the sea. The stiff blue clay makes very adhesive mud after a rain on the steep roads down to Black river, where most of the village is situated. It is finely stratified with layers half an inch or less in thickness.

In this region along the river valley the clay plain is greatly cut up by side streams showing 50 feet or more of the laminated clay absolutely free from stones, evidently laid down in fairly deep water.

North of Matheson no trains were running at the time of my visit, but railway men and prospectors report similar thick stratified clay with a few slight ridges of sand resting on it in places. Scarcely any rock is to be seen along the line north of mile 183; but at Matheson itself the river falls over a cliff of greenstone. Beyond Matheson rock is not reported.

The clay plain to the north of Matheson remains nearly horizontal as far as Cochrane near Abitibi river, where the Temiskaming and Northern Ontario railway joins the National Transcontinental railway. It is stated that in preparing the foundations of the bridge across the Abitibi river the stratified clay was found to be very thick.

### Drift near Long Lake

Long lake lies not far from the western limit of the clay belt, its southern end being only 26 miles north of Jackfish bay on lake Superior. It occupies a long southward bend of the Hudson Bay watershed, which in one place comes within 22 miles of the waters of lake Superior.

There are no striking beaches round the shores of Long lake, perhaps because its valley formed only a very narrow bay of lake Ojibway with very little reach for wave action.

At the southern end of the lake, where the portage comes in from the Black river route, a small sand terrace rises 15 feet above the lake, but this cannot be followed to the north, and may be morainic. The shore of the lake is of well rounded pebbles and boulders up to a foot in diameter, evidently water formed and not simply morainic.

Going down the lake a few ill-defined sand terraces are seen, and some esker-like ridges project into it. Where the axis of the lake bends from northwest to north there are fairly distinct sand terraces rising 30 feet above the lake, *i.e.*, 1,043 feet above the sea.

About one quarter of the way down the lake the sand changes to silt of a yellowish white color, well stratified in some places, but of rather uneven surface, rising sometimes 40 or 50 feet above the water. As the lake widens northwards these terraces diminish in frequency, showing only in bays, and finally disappear altogether. The silt is probably of morainic origin, since in some places it contains stones.

At the north end of the lake, near its outlet into Kenogami or English river, there are considerable areas of lake deposits both sand and clay. The clearing near the old Hudson's Bay post and the new post of Revillon Brothers shows sandy soil rising ten or fifteen feet as a terrace on the east side of the lake. The new post of the

Hudson's Bay Company on the west side is on a low flat of clay rising from three to ten feet above the lake, well stratified in darker and lighter layers an inch thick. The soil is good and is cultivated in a small way.

The terraces at the outlet of Long lake have an elevation of 1,025 to 1,030 feet, and hills of granite and other Archean rocks rise through them.

West of Long lake the country is swampy or muskeg with many small lakes showing little solid rock and no sand or clay; but on Little Long lake boulder clay and morainic ridges are seen, with a few terraces which may be lacustrine. One near a narrows was found to be 23 feet high and to consist of silty sand at the bottom, followed by coarse sand with a thin sheet of gravel on top. The surface is undulating, and suggests a lake deposit at the edge of an ice sheet.

Going down English river northward from Long lake a clay flat is crossed at the Long portage, but this is at least partly of boulder clay, and below a falls at the fourth portage there is a vague terrace at an elevation of 980 feet as determined by aneroid. Most of the river shore to this point, about 15 miles below Long lake, is low, only muskeg showing except at the rapids, where moraine or bed rock comes to the surface.

The general impression obtained is of deposits formed in a small lake with little wave action. Probably the sand and clay terraces were made when the ice front stood not many miles away to the north at an early stage of lake Ojibway; or they may have been formed in a narrow bay stretching northward from lake Algonquin.

Where the National Transcontinental crosses English river south of Pine lake 15 or 20 miles beyond the point reached by my party, the level of the river is 765 feet, and of the land to the east 817 feet, indicating a considerable fall below the fourth portage, if my aneroid determinations are correct.

The two regions just described, along the T. and N. O. railway, and near Long lake and river, are the only ones which I have personally studied, but they are probably typical of the southern margin of the clay belt region as a whole. The lower tracts to the north appear to have the general character of the clay plain north of Matheson. Though this region has been crossed at many points by geological and surveying expeditions, so that there are numerous references to the occurrence of clay or sand or loam in various parts of it, there are scarcely any detailed accounts to draw on for a description of the drift of the region. Very often general statements are made as to clay or loam, but no definite account of the materials, *e.g.*, as to whether the clay is stratified or boulder clay, and whether the sand is in plains or terraces or as esker ridges or kames.

Under the circumstances we may assume that the deposits in the area mapped by the Department of Crown Lands as the "Clay Belt" are in the main lacustrine and represent the deeper water deposits of lake Ojibway, though in parts the clay may be till not much re-arranged by water, and in still others may be unaltered boulder clay. Very frequently, in the parts visited by myself, the stratified clay overlies boulder clay, and one may conclude that the "rock flour" produced by the ice sheets is the source of the clay distributed over the old lake bottom.

While clay covers much of the surface there are tracts of sandy loam or of sand, and numerous areas of muskeg hiding the drift deposits beneath. Undoubtedly also there are hills or ridges of Archean rocks rising at many points, though, according to the reports, making up a relatively small proportion of the surface.

Toward the northwest of the area flat lying limestone, dolomite, or shale of Paleozoic age underlies the drift in some places; and the limestones have improved the soil by adding to the amount of lime present.

### Size of Lake Ojibway and Character of its Shores

It has already been suggested that the waters north of the Hudson Bay watershed probably began as a narrow strip, at first as a bay of lake Algonquin, later as a separate lake at lower levels until the level of the outlet between lakes Abitibi and Temiskaming was reached. It is evident that the area covered by the lake must have been quite variable, so that an estimate of its dimensions at any given time would be hard to make. Its greatest extent at any particular stage could not have exceeded the total area of lake deposits found north of the watershed, and may never have reached those dimensions.

The outlines of the clay belt in Ontario are known roughly, and the width of stratified sand and gravel to the south, representing shallow water and shore deposits is known in a few places. How far the lacustrine clays, etc., extend east of lake Abitibi within the province of Quebec is unknown, but they may be assumed to cover the space below 1,000 feet as shown on the relief map included in the Atlas of Canada.

Within Ontario lacustrine beds extend from north of lake Nipigon to the Quebec boundary, a distance of more than 400 miles in a direction somewhat south of east (110°); and possibly 50 or 60 miles should be added within the Province of Quebec, making a length of about 470 miles. The greatest known breadth of the deposit, somewhat east of north from lake Mattagami, is 160 miles. The average breadth is probably less than half of this, say 70 miles, giving an approximate area of 33,000 square miles. As its maximum extent the area may have been about that of lake Superior. The greatest depth, so far as known, was not more than 500 feet, near the edge of the glacier.

Little can be said of the northern shore of lake Ojibway except that its waves beat upon the rapidly thawing front of the ice. Its southern shore was varied, partly low and marshy, partly cliffs of Archean rock. There was a long narrow bay occupying the present basin of Long lake, and a broad bay with many rocky islands where the watershed bends southwards near the Canadian Pacific railway. The outlet was between rocky walls in a region where hills rise 600 feet or more above the old water level.

### Outlets of the Lake

It has been mentioned earlier that the waters ponded in front of the Labrador ice sheet probably had more than one outlet, beginning with comparatively high levels near Meteor lake, and shifting eastward as the ice withdrew from point to point until the low pass between lakes Abitibi and Temiskaming was set free. The earliest outflow seems to have been in the direction of the Vermilion placers, running from near Meteor lake at an elevation of about 1,400 feet as shown at present towards what are now the head waters of three rivers, the Vermilion, the Wahnapitae and the Montreal. At the earliest stage of all there was probably no river, the water north of the watershed standing at the same level as that in lake Algonquin on the south.

Where the successive lower outlets were placed has not yet been determined; but one seems to have lasted a considerable length of time at a little above 1,000 feet, since sand and gravel terraces and deltas occur at about this level on the line of the T. and N. O. railway a little north of the watershed, along lake Mattagami, and near Long lake.

The lowest outlet southwards was in Quebec a little east of the Ontario boundary, between Mattawagogig or Island lake, draining into Abitibi, and Opasatika lake draining into the Quinze lakes near the headwaters of Ottawa river. There has been no careful study of this low pass, which McOuat described briefly in the Geological Survey report for 1872-3.[20] From his account and from a reference by Professor Parks

[20] p 123.

in the Geological Survey's Summary Report for 1904[21] it appears that the height-of-land portage is at least in part, over Huronian conglomerate, with comparatively high hills not far off. Sand and gravel and clay are mentioned as occurring in the region, but without sufficient detail to settle their character, as morainic or lacustrine.

The elevation of the pass is rather uncertain, McOuat giving it as 305 feet above Temiskaming, which he estimates at 612 feet above sea level, amounting to 915 feet. But later determinations of Temiskaming give from 592 to 578 feet at different stages, which would put the watershed at say 897 feet. On the other hand McOuat estimates that the portage is 60 feet above lake Abitibi, which is 877 feet above sea level at high water mark according to the latest railway surveys, giving 937 feet or somewhat less as the elevation. This outlet is now between 935 and 940 feet above the sea, according to Mr. White, Dominion geographer, which brings it about 100 feet below the present level of the higher shores of lake Ojibway referred to above. There has been, however, a large amount of differential elevation toward the northeast, as shown by the shores of lake Algonquin and the Nipissing Great lakes to the southwest, so that even the beaches from 1,000 to 1,050 feet may have been formed while the lake drained at its lowest outlet, and something should also be allowed for the depth of water in the river flowing out at this point.

At last there came a time when the melting ice front gave access to James bay, and lake Ojibway was drained. Probably the broad lobe of the Labrador ice sheet occupying the shallow bed of James bay was greatly thinned during the existence of lake Ojibway, and the last remnants may have disappeared very rapidly.

While the present sand and gravel deposits of the south shore of lake Ojibway stand 1,000 feet or more above the sea, they were formed at a much lower level, not more probably than 500 feet above the sea, which at that time reached as far up the Ottawa valley as lake Coulonge, where marine fossils have been found. There was a somewhat steep fall from the outlet to lake Temiskaming, and a gentler descent for the rest of the way to tide water.

### Limits of Marine Submergence

When the ice vanished the whole region stood several hundred feet lower than now, and the sea reached 100 miles or more to the south and west of the present shores of the bay. Whether any portion of the bed of lake Ojibway was covered by the sea is uncertain. The marine deposits found along the various rivers are not known to extend to higher levels than about 450 feet as determined by Dr. Bell, while the fresh water clays and sands have not been described as reaching so low an altitude. If we take the northern limit of the clay belt mapped by the Department of Crown Lands as the northern boundary of the lake, the area covered by marine waters nowhere overlapped the old lake bottom except along the lower part of the Ogoki valley.

The enlarged James bay consisted of very shoal and muddy water, much like that of the present bay, where in many places canoes have to keep miles from shore to find a navigable depth.

At present most of the gently sloping plain surrounding James bay is covered with muskeg, owing to the poorly developed drainage, and except along the drier banks of the rivers is of a very hopeless character. There appear to be sand and gravel terraces northward of the clay belt however in some places, as along the Abitibi river between the long portage and Sextant rapids,[22] which would indicate successive stages in the rise of the land after the burden of ice was removed. Whether the James Bay region has continued to rise during historic times is a contested point, Dr. Bell favoring this view and Mr. Tyrrell opposing it.

On the accompanying map the southern limit of marine shells so far as known is indicated, the boundary being taken chiefly from various reports by Dr. Bell.

[21] p. 220. [22] G. S. C., 1902-3, pp. 233-9A., W. J. Wilson.

# CLASSIFICATION AND NOMENCLATURE OF ONTARIO DRIFT

BY A P COLEMAN

The word "drift," as applied to the loose materials of the Pleistocene, is always used in the singular in America; though from the variety and complexity of the deposits grouped under the term, the English usage of "drifts," in the plural, might seem more appropriate.

In the Province of Ontario the drift deposits are extraordinarily complex in their relationships as now worked out, and correspondingly difficult to correlate and classify. The only serious attempt to bring them within the limits of a classification is that of the Geology of Canada,[1] where a map is given with colors for subdivisions named partly from localities and partly from characteristic fossils. The scheme is as follows:

III.

Shell marl, calcareous tufa, peat.
Ochres, bog iron and manganese ores.
Modern alluvions.

II.

| *Western Canada.* | *Eastern Canada.* |
|---|---|
| 2. Algoma sand. Artemesia gravel. Saugeen fresh water clay and sand. | 2. Saxicava sand. |
| 1. Erie clay. | 1. Leda clay. |

I.

Boulder formation or glacial drift.

This classification was cautiously put forward and was evidently not looked on as final, though it served a useful purpose in the earlier studies of our Pleistocene geology. Now, however, it has become a serious stumbling block, since it is not based on real relationships either of time or origin. Its basis is lithological rather than geological, and even the lithology does not always hold.

The lowest division, the "boulder formation or glacial drift," is now known to be far from a unit, since boulder clays of three or four ages occur in the Province. The subdivisions of No. II., so far as eastern Ontario are concerned, are fairly satisfactory; but those of western Ontario are badly confused, each of them containing deposits of several different origins and ages.

At the time when the classification was framed, the long and complicated Pleistocene history of the region had not been worked out, and the lithological method adopted was, of course, the only possible one.

Now, however, the broad lines at least of the history are well known, and it is certainly desirable to arrange a classification in accord with the historical facts.

[1] 1863, pp. 887-917.

## Pleistocene History of the Region

### Glacial and Interglacial Periods

The series of events in the Pleistocene history of the region of the St. Lawrence and the Great lakes may be rapidly run over in order to furnish a basis for constructing a suitable classification of the deposits themselves.

In Ontario the last division of the Paleozoic and the whole of the Mesozoic and Cenozoic are a blank, up to the beginning of the Pleistocene, which may be dated at the advance of the earliest ice sheets of the Glacial Period.

It is probable that the vast mantle of weathered materials resulting from the long dry land conditions has been completely removed by the glaciers advancing from the north and northeast, and is now represented only in the immense drift deposits of southern Ontario and the states to the south. Up to the present no remnant of preglacial deposits later than the Devonian is known.

The succession of ice advances has not been worked out so completely for Ontario as for the northern United States, where the different sheets of till with their intervening soils or stratified interglacial beds have been pretty satisfactorily distinguished, partly by their order of superposition and partly by the more or less complete weathering of the boulder clay.

So far as known the oldest ice advance recorded in Ontario, that which formed the till overlying the Hudson shale at Toronto, corresponds to the Illinoian of the American geologists. After this comes the great interglacial period of the Toronto formation; followed by a glacial advance probably corresponding to the Iowan. Then another interglacial break intervenes, worked out especially by Dr. A. W. G. Wilson, which may be called the Clarke Interglacial Period from a locality where he found it well developed. The last of the ice advances is apparently without doubt the Wisconsin, which has left the main imprint on the topography of the region.

It will be seen from the above outline that the "boulder formation" or "glacial drift," as shown along lake Ontario is very complex in origin, and must really be split up into several formations resting more or less unconformably on one another, and requiring for their deposit a lapse of time running probably into hundreds of thousands of years.

The history as given above applies especially to the region of Toronto and Scarboro' Heights, where the main succession has been worked out by Dr. Hinde[2] and the present writer[3] and the later part largely by Dr. Wilson.[4]

An almost equal complication is found along the north shore of lake Erie, where in many places cliffs of 100 or 150 feet disclose 2 or 3 beds of boulder clay with one or two interglacial beds; and also in the results of well drilling in the southwest peninsula.

It may be taken for granted that the last glacial deposit in all its manifestations, as boulder clay, morainic ridges or kame gravels, belongs to Wisconsin time.

### Glacial and Post-Glacial Lakes

As the Wisconsin ice sheet slowly thawed from Ontario, various bodies of water followed up the glacial front, first lake Warren over part of the basins of the Upper lakes, then lake Algonquin covering most of their area, while lake Iroquois occupied the basin of lake Ontario for at least part of the time; and finally the Nipissing Great lakes, no longer ice-dammed, covered practically the same area as lakes Superior, Michigan and Huron.

[2] Trans. Can. Inst., Vol. VIII., Part I., pp. 11 21. [3] Canadian Journal, Apr. 1877, pp. 3-28. [4] Interglacial Periods in Canada, Mexican Geol. Congress.

When the ice had completely left the St. Lawrence region, the land stood much lower than now, and eastern Ontario was covered by an expansion of the Gulf of St. Lawrence as far as Brockville on the St. Lawrence and lake Coulonge on the Ottawa. Its waters rose above the level of what is now lake Ontario, which was however kept fresh by the large volume of water poured in by Niagara river. Professor Fairchild has named this body of water Gilbert gulf.

All these bodies of water formed appropriate deposits; gravel bars and beaches along the shores, especially cutting off bays, stratified sand on lower slopes, and laminated clay in the deeper waters. As the successive lakes sank to lower and lower levels, by the change of outlets and the continuous uplift of the land to the northeast, it is evident that the deep water deposits of the older lakes would be buried beneath those of the later ones, but that the shore deposits, especially along the north shore, represented roughly by the divide between the Great lakes and James bay, would have a different order of succession, the highest being the oldest and the lowest the youngest. The marine deposits of eastern Ontario are still lower and on the whole the youngest of all, though they probably began before the end of the Nipissing Great lakes. Ultimately, as the land rose to the northeast, lake Ontario was cut off from the Gulf of St. Lawrence, which slowly withdrew to its present position, and modern conditions began.

Events since the formation of lake Ontario may be looked upon as recent. They include the cutting of river valleys, the formation of deltas, the filling of small lakes with sediment or peat, etc.; and correspond to division III. in the Geology of Canada.

### Nomenclature and Correlation of Pleistocene Deposits

From the historical sketch given above it will be seen that our drift includes at least three sheets of boulder clay, two sets of interglacial sands and gravels, the shore and deeper water deposits of four extinct lakes, and in eastern Ontario marine deposits. In the classification given in the Geology of Canada the last subdivision, that of the marine deposits, is perhaps sufficiently provided for in the terms "Leda clay" and "Saxicava sand"; though possibly certain shell-bearing gravels containing saxicavas, formed upon or against morainic or kame-like ridges in eastern Ontario, might receive a separate name.

The freshwater and glacial deposits however are quite inadequately treated. The "Boulder formation" may be looked on as representing the Wisconsin, or last, sheet of till; but the earlier boulder clays and the interglacial beds are not distinguished at all.

The term Erie clay is applied in the Geology of Canada to a blue clay, partly stratified, but referred to as almost always containing pebbles and stones, often striated. In the field it seems to have included interglacial, partly stratified glacial, and also post-glacial, lacustrine clays, which, from the description have the common features of being blue and calcareous, often with too much lime to burn for brick. In origin, these clays include deposits made in several of the glacial lakes, such as Iroquois and Algonquin.

The Saugeen clay seems from its description to be weathered lacustrine clay, brown and burning to red brick. In some places it is merely the upper 3 feet or so of weathered clay above the blue unweathered Erie clay; in others it is said to be unconformable and to have a bed of sand between it and the Erie clay. From the localities mentioned it must be of several different ages. In the map of "Superficial Deposits" no color is assigned to the Saugeen clay, which is evidently looked on as simply the upper section of the stratified Erie clay.

The Artemesia gravel as mapped includes partly kame gravels of the morainic ridges crossing southern Ontario, and partly old beach gravels, especially of lakes Warren and Algonquin.

The Algoma sand consists mainly of old delta sands, etc., of lake Algonquin and the Nipissing Great lakes, but probably includes also some overwash deposits from the front of the Wisconsin glacier.

### Classification

It is probably best to discard all the terms used in the 1863 classification rather than to try to adjust them to new meanings, and the writer suggests that names derived from the ice sheets and bodies of water which formed the deposits be used instead. The following scheme is framed with that in view:

| | In S. Western Ontario. | | In E. Ontario. |
|---|---|---|---|
| | *Recent Deposits.* | | *Recent Deposits.* |
| Lacustrine | Nipissing clay, sand, and gravel.<br>Algonquin clay, sand, and gravel.<br>Iroquois clay, sand, and gravel.<br>Warren gravels. | Marine | Saxicava sand and gravel.<br>Leda clay. |
| Glacial | Wisconsin moraines.<br>" till. | | Wisconsin moraines.<br>" till. |
| Interglacial | Clarke interglacial sands and clays. | | |
| Glacial | Iowan till. | | |
| Interglacial | Toronto formation { Scarboro beds. Don beds. | | |
| Glacial | Illinoian till. | | |

The Illinoian and Iowan till sheets and the two interglacial deposits are well displayed along the north shore of lake Ontario, and probably occur also along lake Erie, but have not been distinguished elsewhere in Ontario.

In most cases we already have sufficient information to place any given Pleistocene deposit in its proper position in the classification just outlined, and the system is flexible enough to provide for new advances in our knowledge.

For Ontario north of the Hudson Bay watershed the classification would have to be modified in certain ways. Resting on boulder clay of Wisconsin age we have shore formations of lake Ojibway—Ojibway gravel and sand—to the south, merging northwards into Ojibway clay; beyond which are the marine clay deposits below 450 or 500 feet above James bay,—Leda clay or James Bay clay, as it may be called. The peat beds overlying the Ojibway freshwater and James Bay marine clays may be looked on as belonging to recent times, and so hardly require a separate formational name.

At present it might be difficult to prepare a map showing these various Pleistocene formations for all Ontario, but there is information enough at hand to map the Great Lakes region with fair completeness except where Algonquin Lake deposits have been overlain by later sands and clays of the Nipissing Great lakes. In that part of Old Ontario the relations must be very complex.

End of Part 1.

# INDEX VOL. XVIII, PART I.


PAGE.
Aaba Cobalt Mines, Ltd .... 43
*Abies balsamea*. *See* Balsam.
Abitibi lakes.
Altitude .... 293
Explorations on and near, report by M. B. Baker .... 263-283
Glaciation in region of .... 288, 289, 292
Remnant of L. Ojibway.
Abitibi river.
Log raft on, photo .... 267
Photo of portion .... 263
Notes .... 264
Terraces .... 293
Accidents. *See* Mining accidents.
Acdus Mineral Co .... 44
Acreage tax .... 40, 41
Actinolite.
Abitibi dist .... 280
Actinolite schists.
Onaman Iron range .... 215
microphoto .... 242
Adams, James .... 115
Adrian Wolverine Oil Co .... 45
Agassiz lake (glacial) .... 284
Agaunico Mines Dev. Co .... 43
Agglomerate.
Onaman Iron range .... 226-231
Onaman Iron range, photos .... 222, 226
Red Paint river, photo .... 206
Agnese, C .... 57, 69
Agricultural land.
Abitibi dist .... 267, 282, 283
Glacial lakes .... 284-293
Long lake, Nipigon dist .... 149
Mount Etna lavas .... 240
Onaman Iron range .... 200, 201
Aha, John .... 59
Air.
As power for Cobalt mines .... 94
A L 2-5 iron locs .... 168, 170
A L 6 iron loc .... 166
A L 428, 431, 438, 439 440 iron locs .... 146
A L 429, 431, 432, 436, 444 iron locs .... 148
A L 561-564 iron locs .... 183, 188, 191, 192
Alberta.
Glacial period in .... 284
Alberta Portland Cement Co .... 45
Alder.
Onaman Iron range .... 300
Alexandra Mining Co .... 45
Alexo nickel mine .... 23, 24
Algoma Commercial Co .... 216
Algoma Development Co .... 43
Algoma Mining dist.
Revenue .... 38
Taxable areas in .... 42
Algoma Power Co .... 92
Algoma Steel Co .... 25, 26
Algonquin lake (glacial) .... 251, 284, 286, 293, 295
Allen, R. C.
Report by, on Woman River Iron Range .... 254-262
Alpine Mining Co .... 44
Alsip, A. A .... 91
American Drummer Cobalt Silver Mg. Co .... 43
American Smelting and Refining Co .... 13
Americana Cobalt Silver Mg. Co .... 44
*Amnicola.*
Pic river .... 153
Amphibole-magnetite chert.
Analysis and microphoto .... 258
Amphibolite schist.
Abitibi dist .... 272
Analysis.
Amphibole-magnetite rock .... 257
Diabase .... 249
Iron ore, Helen mine .... 90
Hematite lake .... 188
Little Bear lakes .... 186
Onaman range .... 243
Jasper slate .... 244
Magnetite slate .... 214
Methods of, at Belleville .... 53, 54
Peridotite, various .... 274
Water, English River dist .... 192, 193

PAGE.
Anderson, Glenn .... 108
Anglo-French Nickel Co .... 13, 42
Animikie formation.
Nonwatin Lake region .... 174
*Anodon.*
Pic river .... 153
Anthracite (?).
Rossport, near .... 49
Anzhekumming (Upper Manitou) lake .... 79-81
Apatite statistics .... 6, 9, 37
Argentite Mining Co .... 96
Argentum Mines, Ltd .... 43
Armour tp .... 50
Arsenic.
Industry .... 31
Cobalt, Ont .... 13
Statistics .... 5-8
Arsenopyrite. *See* Mispickel.
Artemesia gravel .... 294, 297
Asbestos.
In peridotite rocks .... 175
Ascham, Prof. Ossian .... 193
Assay office. *See* Government Assay office.
Atikokan.
Boring near .... 52
Atikokan Iron Co .... 25, 84
Auld tp .... 48
Aureole Mining Co .... 43
Aylen river, Abitibi dist .... 272

Badger Mines Co .... 43, 96
Badger silver mine .... 12, 96
Bailey, A. C .... 125
Bailey silver mine .... 15, 98
Bain, C .... 198
Bain iron claims .... 231
Baker, M. B.
Report by, on Lake Abitibi area .... 263-283
Balbach Smelting and Refining Co .... 13
Balsam.
Abitibi area .... 267
Onaman Iron range .... 200
Banville, M .... 66, 70
Barber tp.
Silver mining in .... 48, 125
Barley.
Abitibi area .... 267
Barlow, H. C .... 54
Barnet, J. F .... 118
Barrie, Ont .... 283
Barthe, L. H .... 105
Bartlett, James .... 115
Bascom, F .... 223
Bass, black.
Nipigon Lake dist .... 179
Bay Lake and Montreal River Mg. & Dev. Co .... 44
Bayley, W. S .... 226, 239, 276
Beach Bros .... 94
Beaches. *See* Terraces.
Beans.
Onaman Iron range .... 200
Bear.
Onaman Iron range .... 209
Photo of, at Indian camp .... 178
Beard, C. E .... 116
Beaver.
Onaman Iron range .... 201
Beaver Consolidated Mines, Ltd .... 59, 70, 96
Beaver Dam lake .... 170, 172
Beaver Oil and Gas Co .... 36
Beaver river.
Bog iron ore near .... 188, 191
Beaver silver mine .... 12, 84, 96
Beaver Superior Silver Mines, Ltd .... 84
Beck, J .... 81
Beck silver mine .... 12
Beer, Sondheimer Co .... 13
Belanger, E .... 63, 70
Belinski, Nicholas .... 58, 70
Bell, Dr. Robt .... 144, 149, 153, 155, 163, 176, 177, 288, 293
Bell, Mr .... 149
Belleville. *See* Government Assay Office.
Belleville Portland Cement Co .... 29
Bellin, N .... 265

PAGE.
Bell's Lake Portland Cement Co. ..... 43
Bellwood, Ont ..... 19
Belmore bay, Sturgeon lake ..... 82
Belmore Bay Gold Mg Co ..... 82
Belyea, C. W ..... 47, 48
Bensley, Prof ..... 196
Benton, James ..... 139
Bernier, E ..... 66, 70
Berry safety catch ..... 75
Bertie Natural Gas Co ..... 36
Big Fissure Mg. Co ..... 44
Big Flat Rock portage, Black Sturgeon river ..... 179
Big Moose Silver Cobalt Mg. Co ..... 44
Big Pete Canadian Mines ..... 132, 270
Big Pete claim ..... 279
Bijko, Andruch ..... 55, 69
Bilsky, A. M ..... 114, 119, 125
Birch.
  Abitibi dist ..... 267
  Nipigon lake, north of ..... 157
Birch, white.
  Onaman Iron range ..... 200
Black Donald Graphite Co ..... 43, 137, 139
Black lead. *See* Graphite.
Black river, L. Superior.
  Altitude of divide near ..... 286
  Terraces near ..... 141, 290
Black Sturgeon bay, L. Nipigon ..... 177
Black Sturgeon lake.
  Iron near ..... 168-173
  Notes on ..... 176, 177
  Trees on ..... 179
Black Sturgeon river.
  Description and geology ..... 163, 164, 166, 168
  Photo ..... 167
Blackburn, Russell ..... 140
Blue, Archibald ..... 11
Blueberries.
  Onaman Iron range ..... 200
Blueberry claims ..... 92
Blytheswood oil field ..... 34
Bobs lake, Ont ..... 140
Boerth gold mine ..... 133
Bog iron ore. *See* Limonite.
Boring.
  Winter Camp claims, photo ..... 245
  With Govt. drill. *See* Govt. Diamond drill.
Borne, F. J ..... 111
Bornite.
  Foley tp ..... 50
Boston International Oil & Mining Co ..... 45
Boston tp ..... 276
Bothwell oil-field ..... 33, 34
Boulders.
  Abitibi dist., photo ..... 281
  Haystack mount ..... 161
  L. Nipigon, north of ..... 160
  photo ..... 142
Boulder clay.
  Black Sturgeon lake ..... 170
  Black Sturgeon river ..... 166
  English river ..... 291
  Lake Erie ..... 295
  Nonwatin lake ..... 166
  Pic river ..... 153
  T. & N. O. railway ..... 289
Boundary Coal Mg. Syndicate ..... 44
Bourke's station, T. & N. O. Ry ..... 279
Bousquet silver mine ..... 123
Bowen, N. L ..... 263
Bowen silver mine ..... 27
Bowbay, Thomas ..... 89
Bowker, S. T ..... 47, 49
Bowles, O ..... 141, 180, 196
Bowyer tp ..... 278
Boyce, A. H ..... 92
Boyd-Gordon silver mine ..... 49
Brant Portland Cement Co ..... 44
Brebner, D. A ..... 140
Breccia, volcanic.
  Woman River Iron range ..... 259, 260
Breeches Lake Mg. Co ..... 44
Brennan, W ..... 67, 70
Brewster tp ..... 47
Bricks.
  Industry ..... 27, 29
  Statistics ..... 5, 9
Brigstocke, R. W ..... 105
Brock, R. W ..... 268, 270, 272, 277, 279
Brockville, Ont ..... 296
Brooks, T. H ..... 130
Brough, A ..... 123
Browne, D. H ..... 86

PAGE.
Bruce, E. L ..... 263
Bruce mines.
  Changed hands ..... 84
  Notes on ..... 89
Bruce Mines, Ltd ..... 44
Bryce, Robt. A ..... 96, 118
Brydge Syndicate ..... 115, 119
Bucke tp ..... 104, 119
Backingham, Que ..... 37
Buffalo silver mine.
  Accidents ..... 59, 70
  Concentrator at ..... 12
  Dividends from ..... 17
  Producing ..... 10
  Production ..... 15
  Report on ..... 98
Building material.
  Statistics ..... 5, 9
Bunting, R. F ..... 139
Burke, A ..... 65, 70
Burke, J ..... 65, 70
Burrows, A. G ..... 94, 122
Burwash, E. M ..... 288
Burwash, Ont ..... 19
Butorac, P ..... 57, 69

Cable Silver Cobalt Mines ..... 43
Calcite.
  Peterson lake ..... 51
Calcium carbide.
  Statistics ..... 5, 9
Calcium carbonate.
  Red Paint lake ..... 252
Calgary, Alta ..... 284
Calligaro, John ..... 57, 69
Campbell and Deyell ..... 119
Canada.
  Glacial period in ..... 284
  Gravels and clays in, classification ..... 294
  Mineral output compared with Ontario ..... 7 8
  Limonite deposits in ..... 194, 195
Canada Corundum Co ..... 37, 140
Canada Imperial Mines, Ltd ..... 43
Canada Iron Furnace Co ..... 25, 133
Canada Mineral Waters, Ltd ..... 45
Canada Pulverizers Co ..... 84
Canadian Copper Co.
  Accidents ..... 54, 55, 69
  Mining by ..... 21, 84, 86, 87
  Mining, Dundonald tp ..... 23
Canadian Exploration Co ..... 45
Canadian Gypsum Co ..... 45
Canadian Lead Mg. & Smelting Co ..... 44
Canadian Oil Companies, Ltd ..... 43
Canadian Oil Refining Co ..... 35
Canadian Ores, Ltd ..... 95
Canadian Portland Cement Co ..... 30
Canadian Salt Co ..... 33
Cane tp ..... 48
Canuck Silver Mines, Ltd ..... 104
Carbon di-oxide.
  Weathering of minerals by ..... 193
Caribou.
  Onaman Iron range ..... 200
Caribou lake, Ont ..... 159
Carleton co.
  Limonite in ..... 194
Cart lake ..... 107, 112
Carter and Kittermaster ..... 33
Cartier, Ont ..... 287
Cartwright, B. E ..... 111
Casey Cobalt silver mine
  Notes ..... 99
  Producing ..... 10
  Production ..... 15
Castor lake ..... 231, 232
Cattanach, A. J ..... 11
C. E. Claim ..... 130
Cedar.
  Black Sturgeon river ..... 168
  Nipigon Lake dist ..... 157
  Onaman Iron range ..... 200
Cement.
  Industry and production ..... 29-31
  Statistics ..... 5, 9
Century Silver Mg. Co ..... 104
Cereals.
  Abitibi area ..... 267
Chalcopyrite.
  Abitibi lake ..... 269
  Madoc tp ..... 135
  Shedden tp ..... 51
  Timagami area ..... 132

PAGE.
Chalmers, Dr. Robt ....186, 195
Chamberlin, Prof. T. C...... 240
Chambers-Ferland Mg. Co.
Capital and date of charter.... 43
Notes.... 101
Photo.... 97
Producing.... 10
Production.... 15
Royalties.... 40
Chapleau, Ont.... 287
Charlton, Ont.... 18
Chartrand, W.... 94
Chatham, Ont.
Gas rates.... 36
Chandiere river, Que.
Platinum in.... 275
Chert.
Larder lake.... 270
Onaman Iron range....236, 237, 243
Onaman, microphotos.... 248
Woman River Iron range....255-257
microphotos....258, 259
Chiocchio, Panfilo.... 63, 70
Chown Lake Cobalt Mines.... 43
Chown tp.... 47
Christie tp.... 50
Chromite.
Abitibi dist.... 273
Church, L.... 109
Chynoweth, James.... 89
Chynoweth, S. C.... 89
City of Cobalt silver mine.
Accidents....60, 69
Dividends.... 17
Producing.... 10
Production.... 15
Report on.... 99
Clarke, F. W.... 240
Clays
Ontario, classification and nomenclature....295-297
*See also* Boulder clay, Saugeen clay, etc. and next refs.
Clay bank.
Photos....150, 152
Clay belt.
Nipigon dist.... 149
Clay, stratified.
Black Sturgeon river.... 165
Mud river.... 160
Clergue tp....23, 50
Cleveland Gold Mg. Co.... 9
Climate.
Onaman Iron range.... 200
Clinton silver mine.... 49
Clydack, Wales.... 23
Coal.
Accidents in mining.... 71
Cost at Cobalt.... 94
Rossport, near.... 49
Cobalt.
Arsenic from.... 31
Cobalt, Ont.... 13
Gowganda dist.... 95
Prices and statistics....5, 6, 8, 11
South Lorrain tp.... 50
Cobalt, Ont.
Accidents at....73, 78, 94
Clay deposits at, altitude.... 288
Fire at, photo of effects.... 97
Labour at.... 14
Refining plant for ores of, Sudbury.... 86
Silver mining. *See* Cobalt dist.
Terraces south of.... 289
Cobalt and Larder Lake Gold Mg. Co.... 132
Cobalt Central silver mine.... 98
Notes.... 100
Photo.... 102
Cobalt district.
Lower Huronian in.... 279
Silver mining in....9, 11, 94-113
shipments from.... 15
Cobalt lake.
Mining beneath.... 109
Mining on. *See* Nipissing silver mine.
Photo of....97, 110
Purchase of bed....38, 48
Cobalt Lake silver mine....10, 15, 104
Cobalt Rosario Mg. Co.... 44
Cobalt Silver Hill Mines, Ltd.... 43
Cobalt Silver Producer Co.... 44
Cobalt Silver Queen silver mine....10, 15, 17, 115
Notes and photo.... 117
Cobalt Station Grounds Mg. Co.... 43

PAGE.
Cobalt Townsite silver mine....10, 15, 104
Cobalt Treasure Mg. Co.... 43
Cochrane, Ont....289, 290
Coe and Rankin.... 134
Coe Hill iron mine.... 27
Cohen, S.... 103
Cole, Arthur A....15, 268
Coleman, Dr. A. P.
Minor refs....162, 239, 251, 276
Notes by, on nickel, Dundonald tp....23, 24
Report by, Black Sturgeon Lake Iron Region 163-179
Iron Ranges, Nipigon dist....141-153
Lake Ojibway....284-293
Classification and Nomenclature of Ontario drift....294-297
Coleman Development and Calumet Mg. Co.... 103
Coleman mining div....47, 49
Coleman tp.
Silver mining in. *See* Cobalt, Ont.
Collins, W. H....159, 249
Colonial Portland Cement Co.... 30
Colonial silver mine....10, 13, 15, 94, 104
Colorado, U.S.
Accidents in mines....71, 72
"Cols."
Notes by Coleman.... 286
Columbus Cobalt Silver Co....60, 69, 103
Columbus silver mine.... 103
Comber oil field....33, 34
Companies. *See* Mining companies.
Concentrators.
Cobalt, Ont....12, 94, 111
Conger tp.... 50
Conglomerate.
Johnson creek, photo.... 226
Onaman Iron range....226-230
Coniagas Reduction Co.
Capital and date of charter.... 45
Minor refs....12, 13, 42
Coniagas silver mine.
Concentrator at.... 12
Dividends.... 17
Producing.... 10
Production.... 15
Report on....99, 100
Conmee tp.
Boring in, with Govt. drills.... 51
Consolidated Exploration Co.... 43
Consolidated Gold and Silver Mines.... 44
Consolidated Mg. and Smelting Co.... 13
Consolidated Silver Cobalt Mines.... 105
Constot, Constant....66, 70
Construction material. *See* Building material.
Contact metamorphism.
Onaman Iron range....215-217
Copper.
Bruce Mines dist.... 89
Louet tp.... 50
Moose mountain.... 89
Statistics....5, 6, 8
Sudbury dist....25, 86, 89
Copper Cliff.
Accidents at....55, 69
Arsenic produced at.... 31
Nickel mine idle.... 21
Smelter at.... 21
Copper pyrites.
Abitibi lake....269, 270
Dundonald tp.... 24
Cordick, S.... 139
Corkhill tp.... 47
Corkill, E. T.
Report by, on Mining Accidents....54-78
Report by, on Mines of Ontario....79-140
Corniferous formation.
Oil fields.... 34
Corundum.
Craigmont.... 140
North Carolina.... 275
Statistics....5, 9, 37
Cosgrove, Thomas....64, 70
Cottock, Jamb....56, 69
Couchiching falls, Abitibi river....265, 266
Couchiching series.
Nipigon dist.... 144
Nonwatin Lake dist.... 173
Coudreau lake.... 32
Coulonge lake....293, 296
Cragg, Shirley R.... 125
Craig, B. A. C.... 136
Craig gold mine.... 132
Craig pyrites mine.... 136

PAGE.

Crean Hill copper mine.
Accidents at and near....54-56, 69
Notes and photo....86, 87
Production....21
Creighton nickel mine.
Accidents at....55, 56, 69
Notes....86
Production....21
Crooked rapid, Abitibi river....264
Cross lake....116, 121
Crossheads in shafts....75
Crown Reserve silver mine.
Accidents at....60, 69
Dividends from....17
Govt revenue from....39, 40
Producing....10
Production....15, 94
Report and photo....101-103
Crysler-Niles Mining Co....44
Crystal Falls dist, Mich....255, 261
Crystal Gold Mg. and Milling Co....9, 44
Culbert, M. T....115
Culver, F. L....126
CzKucz, Peter....58, 70

Dale, F. M....91
Dane, Ont....289, 290
Darby Mines Ltd....43
Darby Mountain Mg. Co....43
Darby silver mine....128
Davide, Commoso....55, 69
Davidson, Walter S....141
Davis, H. P....105, 116
Davis Fraction silver mine....105
Dawson, S. J....11
De Blois, W. H....136
Deer, red.
Nipigon Lake dist....179, 200
Deloro, Ont....31
Delora Mining and Reduction Co....12, 13, 42
Deseronto Iron Co....25
Detola gold mine.
Notes and photo....80, 81
Detola Mg. and Development Co....81
Develin Mining Co. Ltd.
Capital and date of charter....44
Installing machinery....49
Work by....125
Diabase.
Abitibi dist....269, 278, 280, 281
Black Sturgeon lake....177, 178
Black Sturgeon river....163
photo....164
Cobalt....100, 114, 124
Fraser Lake region....175, 176
Gowganda dist....95
Hubert lake, near....127
Long lake, Nipigon dist....144
Nipigon lake north of....156-162
Nonwatin Lake region....165, 166, 170-174
Onaman Iron range....203-207, 211, 217, 233, 249
notes....247, 249
South Lorrain tp....123
Diabase mt., Cobalt....100
Diamond drills. *See* Govt. Diamond drills.
Diana, John De....67, 69
Diorite
Abitibi dist....272
Onaman Iron range....246, 247
Round Lake dist., petrography....157
Dividends.
Cobalt mines....16, 17
Dobie and Reeves silver mine....49
Dr. Reddick. *See* Reddick.
Dogs for transport....145
Dog lake....286
Dokis river....276
Dolomite.
Abitibi dist....276
Larder lake....270
Stringers of quartz in, photo....268
Dominico, Tom....56, 69
Dominion Development and Mg. Co....43
Dominion Improvement and Development Co....32
Dominion Natural Gas Co....86
Dominion Nickel Copper Co....45, 89
Dominion Sewer Pipe Co....29
Donaldson, W. J....99
Dougherty, M....67, 70
Dougherty, M. E....63, 70
Douglas Mining Co....82
Drain tile industry....29
Dreany, H....133

PAGE.

Drift.
Long lake, Th. B.d....290
Ontario, classification and nomenclature....293-297
Drummond silver mine.
Accident at....60, 69
Air power from....106
Notes....105
Photo....102
Producing and production....10, 15
Partnership concern....16
Dubreuil, A....63, 70
Duisdank, Mike....56, 69
Drummond Gold Mines Co....43
Dumortierite.
Onaman Iron region....245, 253
notes....212, 214
microphoto....242
Dundonald tp.
Nickel in....23, 24, 50
Dunite.
Analysis....274
Durboyk, Alex....58, 59, 70
Dutton oil-field....33, 34
Dynamite, notes on....77
Dynamo-regional metamorphism.
Onaman Iron range....212

E 94-97 iron locs....170, 174
E 200 iron locs....170
Earley, G. R....81
Earlton, Ont....289
Eastbourne Cobalt Mines....43
Edmonton, Alta....284
Elarton Salt Works....33
Electro-Metals Co....26
Electrolytic smelting....26, 27
Elk Lake. *See* Smyth.
Elk Lake Discovery Mines, Ltd.
Capital and date of charter....44
Installing machinery....49
Elk Lake Discovery silver mine....125
Elk Lake dist.
Silver mining in....16, 125-127
Elk Lake Silver Cobalt Mg. Co....126
Elkhart Proprietary Silver Mines....44
Elkhorn, Ont....28
Elkhorn Mg. Co....44
Elklake-Cobalt Mines, Ltd....43
Ells, Dr. R. W....188
Empire Gold Mg. and Milling Co....81
Empire Limestone Co....36
Empire Mining and Milling Co....9
Empire Salt Co....33
Empress mine....141
Englehart, Ont....283, 289
English (Kenogami) river.
Falls on, photo....143
Lake deposits near....290, 291
Limonite on, report....180-195
Eplett silver mine....108
Erie clay....294, 296
Eskers.
Onaman Iron range....204
Essex gas field....35
Evans, J. W....26, 27
Everett lake....95
Excelsior Cobalt Larder Lake Mg. Co....44
Excelsior Mica Mines, Ltd....43
Exeter Salt Works Co....33
Exploration Syndicate of Ontario....43
Explosives.
As cause of accidents....72, 73, 76

Farah Mining Co....44
Farah silver mine....105
Farr tp....125
Faults.
Nonwatin Lake dist....175
Onaman Iron range....210
Fedake, W....57, 69
Fee, T....111
Feldspar.
English River dist., in sand....191
Parry Sound dist....50
Richardson mine....136, 137
Statistics....5, 9
Fires. *See* Mining Accidents and Forest fires.
Fish.
Nipigon Lake dist....179
Onaman Iron range....200
Fisher.
Onaman Iron range....201
Fisher, Norman R....103, 117, 122

PAGE.

Fisher silver mine.... 108
Fishleigh, Roger......59, 70
Flaherty, R. H...... 245
Flaherty syndicate...... 196
Flat rapid, Abitibi river...... 264
Flat-rock portage, Nipigon river...... 162
Fleming, M...... 127
Fleming, P. J...... 126
Floyd Silver Mg. Co...... 105
Fluorspar.
Madoc tp.
Flynn, John...... 92
Flynn, M. T......134, 137
Folding.
Onaman Iron range...... 210
Foley, D......65, 70
Foley tp...... 50
Forest fires.
Onaman Iron range......200, 204
Temagami Forest Reserve...... 19
Forneri Mg. Co...... 44
Fossils.
Coulonge lake...... 293
Pic river...... 153
Foster, R. W...... 128
Foster Cobalt silver mine.
Dividends...... 17
Notes...... 105
Photo...... 106
Producing...... 10
Production...... 15
Foster silver mine (Maple Mt. area)...... 128
Fraleck, E. L......32, 104
Fraser, Allen...... 139
Fraser lake, Ont.
Iron claims near, notes......175, 176
French-Greensmith silver mine......61, 69
Frontenac co.
Feldspar mining in......136, 137
Fruit.
Onaman Iron range...... 200
Fur-bearing animals.
Onaman Iron range...... 201
Fuses, notes on...... 77

G 692-699 iron locs...... 170
G 702-709 iron locs......166, 168
G 711-713 iron locs...... 165
Galena...... 135
Gamble tp...... 47
Game.
Nipigon Lake dist...... 179
Onaman Iron range...... 200
Gandos, John......55, 69
Garnets.
Abitibi lakes...... 280
Onaman Iron range...... 218
Garnetiferous slate.
Onaman Iron range...... 235
Garson nickel mine......23, 88
Gas tax......40, 41
Gates, M...... 91
Gates silver mine. *See* Mother Lode Mg. Co.
Gavin Hamilton Mg. Co.
Capital and date of charter...... 44
Installing machinery...... 49
Work by...... 126
General Electric Co......139, 140
Geneva, Ont...... 287
Geological Survey of Canada.
Statistics valued by...... 7
Germany.
Accidents in mines......71, 72
Cobalt silver shipment to...... 10
Gibbs, Henry C...... 84
Gibson, Angus...... 91
Gibson, Thos. W.
Introductory letter by...... 2
Statistical Review by......5-54
Gifford Cobalt Mines, Ltd...... 43
Gifford Extension Mines, Ltd...... 43
Gill, Dr. W. E...... 92
Gillespie, Geo. H......38, 136, 139
Gillespie pyrites mine...... 136
Gillies limit. *See* Provincial silver mine.
Gilmour Mining Co...... 133
Gilt Edge Silver Mg. Co...... 44
Girard, Joseph......64, 70
Giroux lake......114, 115, 122
Glacial lakes.
Report by Coleman......284-293

PAGE.

Glacial striae.
Black Sturgeon lake...... 178
Onaman Iron range...... 252
Glauconite...... 239
Glen lake......100, 105
Glenorchy, Ont...... 9
Glidden, J. N...... 89
Globe Refining Co......137-139
Gneiss.
Onaman Iron range, petrography...... 246
Pic river, photo...... 152
Gold.
Abitibi dist......263, 268-271
Companies floated and working......9, 43-45
Eastern Ontario...... 133
Guibord tp...... 52
Larder lake......96, 128-132, 268
Mining report by Corkhill...... 79
Nighthawk lake...... 268
Montreal River dist...... 49
Munro tp...... 52
Parry Sound mg. div...... 50
Rainy River dist...... 52
Statistics......5, 6, 8
Timagami area...... 132
Gold King gold mine...... 130
Gold Leases, Ltd...... 43
Golden Fleece gold mine...... 133
Golden Reed claims......91, 92
Golden Reed Mg. Co......9, 91
Goldthwait, Prof......160, 251
Good, C...... 81
Gordi, Megali......56, 69
Gould Consolidated Mines Co......106, 115
Government Assay office.
Report......52-54
Revenue......38, 42
Government Diamond drills.
Report......50-52
Revenue...... 38
Gow Ganda King Silver Mines, Ltd...... 43
Gow Ganda Queen Mines, Ltd...... 43
Gow Ganda United Cobalt Mines Co...... 44
Gowanlock, Andrew......67, 70
Gowganda.
Govt. office at...... 48
Photos......14, 18, 20-22, 26
Road to...... 18
Townsite at...... 16
Gowganda lake.
Area withdrawn...... 48
Silver near...... 39
Silver mining, notes...... 95
Gowganda mining div.
Recorders' report on......47, 48
Silver in...... 16
Grace gold mine.
Minor ref...... 9
Notes and photo...... 91
Working...... 84
Grace Mining Co...... 9
Grand bay, Black Sturgeon lake......177, 178
Grand Trunk Pacific railway.
Photo of cut on...... 82
Granite Crushed and Dimension, Ltd...... 43
Graphite.
Eastern Ontario......137, 139
Laurier tp...... 50
Statistics......5, 9
Graphite slates.
Abitibi dist...... 276
Gravel pit.
Dane...... 289
Gray, Young and Sparling...... 33
Great Britain.
Accidents in mines......71, 72
Cobalt silver shipments to...... 10
Great West Coal Co...... 44
Green, W. F...... 196
Green-Mehan silver mine.
Notes......105, 106
Production...... 15
Greenalite......239, 243
Greenstone.
Abitibi dist......279, 279, 283
Conmee tp...... 51
Onaman Iron range......218-220
Woman River Iron range......254, 255, 260, 261
Green lake......180, 183
Grey and Bruce Portland Cement Co...... 30
Grey's Siding Dev. Co......61, 69, 132
Greywacké.
Onaman Iron range......234-236

PAGE.
Griffin, P. H ..... 192, 195
Grimsthorpe tp ..... 133
Gros Cap, Black Sturgeon lake ..... 178
Grouse, Canadian.
Woman River Iron range ..... 201
Grover and Smith ..... 123
Grünerite.
Onaman Iron Range ..... 216
Guelph formation.
Oil fields ..... 34
Guibord tp ..... 52
Gypsum statistics ..... 5, 9

Hall, Dr. R. D ..... 257
Haileybury.
Clay deposits, altitude ..... 288
Terraces at ..... 289
Haileybury Silver Mg. Co ..... 123
Haldimand gas field ..... 35
Halton Oil and Gas Co ..... 43
Hambly, William ..... 86
Hamilton ..... 30
Hamilton and Toronto Sewer Pipe Co ..... 29
Hamilton Brick Co ..... 44
Hamilton Iron and Steel Co ..... 25, 26
Hanlan mica mine ..... 139
Hanna, L ..... 132
Hanover Portland Cement Co ..... 30
Hargrave Silver Mines ..... 40, 44, 106
Harrington, James ..... 67, 70
Harris, George ..... 68, 70
Harris, John G ..... 68, 122, 125
Harris, Mark ..... 123
Harris-Lorrain Syndicate ..... 123
Harris-Maxwell Larder Lake Gold Mg. Co ..... 128-130
Harris pyrites mine. *See* Northland py., m.
Harwood, T. J ..... 109
Haultain tp ..... 48, 95
Hay.
Abitibi dist ..... 267
Hayden, Shirley ..... 66, 70
Hayden, William H ..... 133
Haystack mt.
Iron in ..... 154
Geology ..... 162
Photo ..... 161
Heakes, S. R ..... 107
Heaslip, Ont ..... 289
Height of Land iron claims ..... 246, 247
Height of Land portage, Pic river ..... 171
Heittala, John ..... 55, 69
Helen iron mine.
Accidents ..... 57, 69, 70
Granular pyrite from ..... 32
Large producer ..... 84
Notes and photo ..... 90
Working ..... 25
Hematite.
Atikokan, near ..... 52
Black Sturgeon Lake area ..... 163
Fraser Lake area ..... 175, 176
Little Long lake ..... 148
Nipigon lake, north of ..... 158
Nonwatin Lake area ..... 165, 168, 171
Onaman Iron range ..... 216, 239
Woman River Iron range ..... 256, 259
Hematite lake.
Dog iron ore on ..... 183, 187, 188
analyses ..... 192, 193
photo ..... 190, 192
Hematite slate.
Microphoto ..... 237
Henderson talc mine ..... 137
Hennessey, H ..... 118
Herman, Jos ..... 116
Hermina copper mine ..... 25, 89
Heron bay, L. Superior ..... 153
Hewitt, A. J ..... 96
H F 31-33 gold locs ..... 130, 132
H F 140, 141 gold locs ..... 130
High Falls, Kenogami river ..... 143
High Falls, Michipicoten river ..... 92, 94
High Falls, Spanish river ..... 25
Hinde, Dr ..... 295
Hinds, George ..... 65, 70
H J B 28 to 33 gold locs ..... 130
H J Mining Co ..... 45
Holden silver mine ..... 49
Holliday lake.
Iron near ..... 231
Rocks near ..... 228, 230
agglomerate, photo ..... 206
Holmes Cobalt Silver Mg. Co ..... 44
Holmes Gas Co ..... 44
Hornblende-porphyry.
Onaman Iron range ..... 246
Hornblende schist.
Abitibi dist ..... 272, 277
Hough, J. A ..... 47, 50
Houghton co., Mich.
Accidents in mines of ..... 73
Hound chute, Montreal river ..... 94
Houston, Jos ..... 66, 70, 116
H R 19 silver loc. *See* Keeley silver mine.
H R 21, 22 silver locs ..... 125
H R 24, 25 silver loc ..... 123, 124
H R 76 silver loc ..... 124
H R 85 silver loc. *See* Wettlaufer Lorrain Silver Mines.
H R 88 silver loc ..... 123
H S 109 gold loc ..... 132
H S 114 115 gold locs ..... 128-130
Hubert lake ..... 127
Hudson bay.
Glaciation around ..... 286-288, 292
Hudson shale ..... 294
Hudson's Bay Co.
Long Lake post, photos ..... 144
rocks ..... 143, 145
Hungerford, W. A ..... 135
Hungerford pyrites mine ..... 135, 136
Hunt, T. Sterry ..... 193, 240
Hunter, S ..... 115
Huntingdon tp.
Talc mining in ..... 137
Huntsville, Ont ..... 283
Hurdman, W ..... 119
Huronian.
Cobalt dist ..... 51, 279, 280
Drainage conditions in period of ..... 240, 241
Larder Lake area ..... 279, 280
Onaman Iron range ..... 246, 253
Timiskaming dist ..... 281
"Husky" dogs ..... 145
Hutton tp ..... 276
Hyland Silver Mg. Co ..... 43

Iddings, J. D ..... 217, 223, 261
Illinoian till sheet ..... 297
Ilmenite.
Hay stack mt ..... 154, 155, 162
Imperial Cement Co ..... 30
Imperial Cobalt silver mine ..... 15
Imperial Copper Nickel Co ..... 43
Imperial-Crown Mines, Limited ..... 43
Imperial Gold Mines, Limited ..... 43
(*See also* Laurentian g. m.)
Imperial Oil Co ..... 34, 35
Imperial Otto Mg. Co ..... 44
Indians, photos ..... 26, 171, 173
Ingall, E. D ..... 11
Iowan till sheet ..... 297
Irene Mines, Limited ..... 43
Iron.
Abitibi dist ..... 273
Black Sturgeon Lake reg ..... 163-179
English river, report by Moore ..... 180
Mayo tp ..... 133, 134
Mining, report ..... 25, 27
Mowat tp ..... 50
Nipigon dist., report by Coleman ..... 141-153
N. of Round lake ..... 154-162
Onaman range, report by Moore ..... 196
Port Arthur dist ..... 79
Statistics ..... 5, 6, 8, 27
Woman River dist., report by Allen ..... 254, 262
Iron pyrites.
Abitibi lakes ..... 269, 270, 280
Dundonald tp ..... 24
Hastings co ..... 135
Industry ..... 32
Larder lake ..... 128
National Transcontinental ry ..... 79
Onaman Iron range ..... 216
Statistics ..... 5, 9
Timagami area ..... 132
Vermilion mine. *See* Vermilion py. m.
Iroquois lake (glacial) ..... 284, 295
Iroquois Silver Mg. Co ..... 43
Island lake, Abitibi dist ..... 292
Island rapid, Abitibi river ..... 264
J
Jachee, John ..... 57, 69
Jackfish.
Nipigon Lake dist., photo ..... 176
Jackfish, Ont ..... 141, 142, 286

PAGE.
Jackfish bay, L. Superior ........ 290
Jackpine. *See* Pine, Banksian.
Jacknan, Herbert E ........ 107
James bay.
Glaciation around ........ 286, 293
James tp.
Silver mining in ........ 48, 50, 95, 125, 126
Jarvis Mining Co ........ 12
Jasper.
Nonwatin Lake dist ........ 168, 172
Onaman Iron range ........ 204-217, 231, 232, 241, 245, 246, 253
appearance ........ 252
microphotos ........ 221, 237, 242
photos ........ 233, 247
Woman River area ........ 257
Jasper slate.
Analysis ........ 244
Jaspilite
Abitibi dist ........ 276
photo ........ 275
Onaman Iron range ........ 233, 236-239
Woman River Iron range ........ 255, 256
J B 3 mine. *See* Princess silver mine.
Jeffery, W. H ........ 101
Jeffries creek, Johnson creek ........ 204
Johnson creek, Onaman dist.
Agglomerate and tuff on ........ 226
Iron formation on ........ 231
Minor refs to ........ 198, 199
Moraines on ........ 203, 250-253
Tributaries of ........ 204
Jones, Tom R ........ 98
Julian, A. A ........ 186, 193, 240

Kakka, J ........ 57, 69
Kame.
Larder lake, near ........ 289
Onaman Iron range ........ 204
Kangas, Jno ........ 55, 69
Kasmark, Mike ........ 58, 70
Kat, Steve ........ 58, 70
Kay, G. F ........ 289
Keefer, T. A ........ 11
Keeley-Jowsey-Wood Mine, Limited.
Capital and date of charter ........ 44
*See also* Woods s. m.
Keeley Mine, Ltd ........ 43
Keeley silver mine.
Accidents at ........ 61, 69
Machinery installed at ........ 50
Notes on ........ 123
Photo ........ 124
Producing ........ 10
Gas plant at ........ 95
Shipments from ........ 94
Keene, Irwin ........ 65, 70
Keewatin formation.
Abitibi dist ........ 269, 271, 277-280
iron ore in ........ 273
notes ........ 272, 275, 276
Cobalt dist ........ 51, 114
Earth's condition in, period of ........ 241
English River dist ........ 183
Glacial period in ........ 284
Metamorphism accompanies ........ 209
Nipigon Lake dist ........ 142-146, 155, 157
Nonwatin Lake dist ........ 165, 172, 173, 174
Onaman Iron range ........ 203, 205, 207, 209, 222, 232, 246, 252
South Lorrain tp ........ 123
Sturgeon lake ........ 82
Wettlaufer silver mine ........ 124
Keilty, George ........ 67, 70
Kendall vein, Nipissing mine ........ 112, 113
Kenogami river. *See* English river.
Kenora mining div ........ 47, 48
Kent Bros ........ 32, 140
Kent co ........ 194
Kent gas-field ........ 35, 41
Kerr, H. L ........ 289
Kerr lake.
Photos ........ 101, 102
Purchase of bed ........ 38, 40, 48
Silver mining in ........ 10
Kerr Lake Majestic Silver Mg Co ........ 107
Kerr Lake silver mine.
Accidents ........ 61, 62, 69
Dividends ........ 17
Producing ........ 10, 15
Report ........ 107
Kerry Mining Co ........ 107, 115, 118

PAGE.
Kettle lakes, photos ........ 202, 203, 250, 251
Keweenawan formation.
Black Sturgeon lake ........ 176
Black Sturgeon river ........ 163-166
Description ........ 174
Fraser Lake dist ........ 175
Nipigon lake, north of ........ 157, 159, 162
Nonwatin Lake dist ........ 165-174
Onaman Iron range ........ 204, 205, 207, 233, 253
notes ........ 247, 249
Key Inlet ........ 89
Kielee, John ........ 57, 69
King, J S ........ 263
King, Thomas ........ 62, 70
King Cobalt silver mine ........ 107, 108
King Edward silver mine.
Concentrator at ........ 12
Notes on ........ 107
Producing ........ 10
Production ........ 15
Photo ........ 118
King Edward Silver Mines, Ltd ........ 107
King George Mg. Co ........ 44
Kingston Feldspar and Mg. Co ........ 69, 70
Kinler, J. R ........ 120
Kinmount, Ont ........ 137
Kinnari, Matti ........ 57, 69
Kitchi schists ........ 227
Knight, C. W ........ 280
Knobell, M ........ 171
Kuja, Sali ........ 58, 70
Kumpu, Victor ........ 58, 70

Labour.
Cobalt, Ont ........ 13, 14
Sudbury ........ 23
Labrador ice sheet ........ 284, 287, 293
Labrador tea.
Shebandowan, near ........ 183
Lac a-la Tortue, Que ........ 192, 195
Lac aux Sables, Que ........ 195
Lacey mica mine ........ 140
Lady of the Lake Mg. Co ........ 43
Lakatus, Dimitru ........ 56, 69
Lake Erie.
Boulder clay on ........ 295
Lake Huron.
Salt on ........ 33
Lake of the Woods.
Gold mining in region of ........ 81
Lake Ontario.
Glaciation on ........ 295, 296
Lake Superior.
Copper mining on north shores ........ 83, 89
Glaciation north of ........ 286
Lake Superior Corporation ........ 32
(*See also* Helen iron mine).
Lake Superior Gold and Copper Co ........ 45
Lake Superior portage, Pic river ........ 151 153
Lakefield Portland Cement Co ........ 30
Lalonde, E ........ 67, 70
Lambton oil field ........ 33, 34
Lambton Pressed Brick Co ........ 44
Landenberger, F ........ 133
Lang, H. H ........ 126
Langham Mining Co ........ 126
Lanthanon, Oscar ........ 56-69
Larder lake.
Clay near, stratified ........ 289
Larder Lake Incline Mines, Ltd ........ 43
Larder Lake Mining Division.
Gold in ........ 9, 39, 128, 268, 270
mining, notes ........ 96
recorder's report ........ 47, 49
Huronian ........ 279
Keewatin ........ 272, 277
Larder Lake Proprietary Gold Mg. Co ........ 130, 131
*Larix americana*. *See* Tamarack.
La Rose Consolidated Mines Co ........ 108, 115, 121, 122
La Rose silver mine.
Accidents ........ 62, 69
Dividends ........ 17
Photo ........ 97
Producing ........ 10
Production ........ 15
Report on ........ 108, 109
Last Chance Mining Co ........ 44
Latchford, Ont ........ 18, 49
Laurentian.
Abitibi dist ........ 270-272, 278, 279
Black Sturgeon lake ........ 177
Black Sturgeon river, photo ........ 167, 168

PAGE.

Laurentian.—*Con.*
English River dist........ 183
Nipigon Lake dist........ 141-144, 155, 157, 159
Nonwatin Lake dist........ 165, 166
Onaman Iron range... 203, 205, 209, 215, 222, 246, 253
Quebec prov., limonite areas........ 195
Sturgeon lake........ 82
Laurentian gold mine........ 9
Notes and photo........ 79, 80
Laurentide Mica Co........ 140
Laurier tp........ 50
Lavally, F........ 67, 70
Lavally, W........ 67, 70
Lavas of Mt. Etna........ 240
Lavergne, Emil........ 59, 60, 70
Lavigne, Robert........ 62, 70
Lawson, Prof. A. C........ 226, 286
Lawson, John........ 56, 69, 86
Lawson tp........ 47
Lead statistics........ 8
Leamington.
Gas rates........ 36
Leamington Oil Co........ 36
Leamington oil field........ 33, 34
Leanny, P. J........ 63, 70
Leda clay........ 294, 296
Leeds co........ 194
Legary, Tobias........ 68, 70
Lehigh Portland Cement Co........ 29
Leith, Prof. O. K........ 196, 211, 239, 240, 241, 261, 276
Lemieux, F. F........ 47, 49
Lemieux Silver Mines, Ltd........ 43
Leonard Napoleon........ 62, 70
Leonard, R. W........ 84, 89, 99
Le Page Gold Mg. Co. *See* Grace gold mine.
Leroy lake........ 48
Lettuce.
Onaman Iron range........ 200
Leyson, B W........ 99, 104
Leyson, George........ 106
Lime.
Industry........ 29
Statistics........ 6, 9
Limehouse, Ont........ 30
Limestone.
Black Sturgeon lake........ 178
Oil fields........ 34
*Limnæa.*
Pic river........ 153
Limonite.
Canada........ 194, 195
English river, report by Moore........ 180
Mud river........ 161
Onaman Iron range........ 216
Quebec prov........ 240
Sweden........ 244
Little Bear lakes.
Limonite on........ 180
Map of claims........ 181
Little Conchiching rapid, Abitibi river........ 264
Little Dan mine *See* Sterling mine.
Little Long lake........ 291
Description and iron claims........ 146-148
Map........ 147
Routes to........ 141, 145, 146
Little Nipissing Silver Cobalt Mg. Co........ 109, 115
Little Nipissing silver mine.
Boring at........ 50, 51
Notes on........ 109
Little Nonwatin lake........ 164
Llyod, S. J........ 191
L M 31, 32 gold locs........ 132
Long lake, Nipigon dist.
Glaciation........ 286, 290, 291
Notes and photos........ 142-144, 149
Route to........ 141, 145, 146
Long portage, English river........ 291
Longwell, A........ 89
Loring, F. C........ 125, 127
Loughborough Mica Co........ 44
Loughborough Mining Co........ 32, 139, 140
Longheed, A........ 180
Lount, G. F........ 155
Lount tp........ 50
Low Bush river, Abitibi dist........ 278
Lucky Godfrey Cobalt Mines Co........ 43
Lucky Godfrey silver mine........ 126
Lumbering.
Abitibi river, photo of log raft........ 267
Lyon Mining Co........ 44

McArthur, T. A........ 47, 50
McCallum, M........ 103

PAGE.

McCaskell, G. W........ 104
McConkey tp........ 50
McConnell, Rinaldo........ 118, 139, 140
McCrey creek, Johnson creek........ 204
McCrimmon Montreal River Mines, Ltd........ 43
McDonald, J........ 105
McFadden, D........ 126
McGarry, A........ 122
McInnes, William........ 159
McKay lake, Nipigon dist........ 151, 153
McKay Mining Co........ 43
Mackenzie, Geo. C........ 25
McKenzie Mg. and Expn. Co........ 43
McKerrow, Wm........ 58
McKinley-Darragh-Savage mine.
Concentration at........ 13
Dividends from........ 17
Photo........ 110
Producing........ 10
Production........ 15
Report on........ 109, 110
McLaren, W. L........ 32
McLaughlin-McIntosh silver mine........ 49
McMartin, John........ 132
McMillan, A. J........ 65, 70
McMillan, J. G........ 267
McNaughton, G. F........ 121
McNaughton, G. W........ 139, 140
McOuat, Walter........ 265, 273, 288, 292, 293
McQuire, H. F........ 47, 50
MacVicar, J. A........ 51, 52
McWilliam, J........ 38
Madawaska river.
Waterpower on........ 139
Maddin, S. D........ 109, 119
Madoc, Ont.
Boring at, for fluorspar........ 50, 51
Talc plant at........ 38
Madoc tp........ 135-138
Magee, Boyd........ 123
Magee lake........ 175
Magnet creek, Little Long lake........ 148
Magnet Mines Co........ 43
Magnetite.
Abitibi lake........ 276
Little Long lake........ 146
Niblock (near)........ 185
Nipigon lake, north of........ 158, 159
Onaman Iron range........ 207, 216, 217, 239, 245
analysis........ 243
Rankin iron mine........ 135
Woman River range........ 256-259
Magnetite slate.
Analysis........ 214
Maidens Silver Mg Co........ 43, 124
Maki, Johan........ 57, 69
Manitou lake, Upper.
Gold mining in region of........ 79-81
Mann Bros........ 95
Mann silver mine........ 49
Manufacturers Corundum Co.
Manxman gold mine. *See* Norwalk g. m.
Mapes, L........ 127
Maple City Oil and Gas Co........ 36
Maple Leaf iron claims........ 228, 231
Maple Leaf Mines, Ltd........ 43
Maple Mountain area........ 49, 95, 128
Maps
Iron range north of Round lake........ 156
Lake Ojibway........ 285
Limonite claims near Niblock........ 182
Limonite claims, Little Bear lakes........ 181
Little Long lake, iron claims........ 147
Onaman Iron range........ 197
Quinze route, ref. to........ 265
Woman River Iron range........ 253, 254
Marble Lake Mg. and Milling Co........ 44
Marcell Mines, Ltd.
Capital and date of charter........ 43
Installing machinery........ 49
*Margaritana.*
Pic river........ 153
Marl.
Abitibi dist........ 283
Nipigon lake, southwest of........ 166
Marquette dist., Mich........ 73, 227
Marshall, William........ 132
Marten.
Onaman Iron range........ 201
Martin, D. K........ 104
Martite.
Nonwatin Lake region........ 171
Marvel Silver Mines, Ltd........ 43

PAGE.

Maryland, U.S.
Peridotites from... 274
Matabitchuan river... 94
Matachewan, Ont... 288
Matheson, Ont......263, 264, 290-291
Mattagami lake......288, 292
Mattagami post... 287
Mattawagogig lake... 292
Mayo tp.
Iron mining in... 133-135
Meech, C... 139
Meek, H. C... 87
Meteor lake......287, 292
Mexico silver output... 9
Mica.
Eastern Ontario, mining... 140
Industry......32, 33
Parry Sound Mg div... 50
Statistics... 6, 9
Trade depressed... 139
Mica porphyry.
Woman River Iron range......255, 260
Mica schist
Abitibi dist., petrography... 278
Micanite... 33
Michigan, U.S.
Accidents in mines......71, 72
Peridotite from, analysis... 274
Michipicoten dist.
Mining in, notes and photos......90-94
Michipicoten river.
Waterpower on. *See* High Falls.
Mickle, G. R... 40
Mickle tp......125, 127
Microcline crystal.
Microphoto... 248
Microphotographs.
Onaman Iron range......221, 228, 237, 242
Woman River Iron range......256-259
Midfield Natural Gas Co... 43
Miettinen, Augusti......55, 69
Mikkalo, Emil......63, 70
Miller, Dr. W. G......79, 268, 269, 276, 277, 282
Miller iron claims.
Folding on... 210
Dumortierite in... 213
Iron formation near......231, 232
Pebbles from, photo... 227
Pink garnets near... 218
Rhyolites of... 223
Rocks on and near... 228
petrography......230, 235
slate... 216
Tourmaline in... 217
Miller lake......16, 48, 95
Miller Lake and Everett Mines, Ltd... 43
Miller Lake Mining Co... 44
Milne silver mine... 49
Milton Pressed Brick and Sewer Pipe Co... 29
Mineral Development Co... 45
Mineral production
Report by Gibson......5-54
Mineral Range iron mine......25, 134
Mines and Exploration, Ltd... 43
Mines Finance Co. of Canada... 44
Mining Accidents.
Cobalt... 94
Fires, Beaver mine... 98
Cobalt... 97
Vermilion mine... 83
Victoria mine... 87
Report on... 54
Mining claim No. 223... 61
Mining claims.
How to obtain... 41
Mining Companies.
Incorporated and licensed, 1908......43-45
Mining divisions.
Report on......46-50
Mining lands.
Rentals from... 38
Mining laws.
Improvements in... 46
Timagami Forest Reserve... 19
Mining licenses.
Notes on... 39
Revenue from... 38
Temagami Forest Reserve... 19
Mining revenue... 38
Mining royalties... 38
Mining statistics. *See* Statistics.
Mink.
Onaman Iron range... 201

PAGE.

Minnehaha gold mine... 81
Minnehaha Mg. and Smelting Co... 81
Minnitaki, Ont... 32
Mispickel.
Timagami area... 132
Missinaibi col... 286
Mississagua Development Co... 44
Missouri.
Accidents in mines......71, 72
Mistaken island, Abitibi lake... 279
Mis-to-ogo river... 264
Mohr, E. R... 104
Molybdenite.
Timagami area... 132
Mond Nickel Co... 23
Accidents......58, 70
Mining......84, 87, 88
Monel metal......21, 22
Monk, Stephen......67, 70
Montana, U S.
Accidents in mines... 71
Montgomery, W. R... 124
Montreal river.
For freight... 18
Glaciation on... 292
Power on, for Cobalt... 94
Montreal River Cobalt Silver Mines, Ltd... 43
Montreal River Consolidated, Ltd... 43
Montreal River Development Co... 44
Montreal River Mg. div......47, 95
Montrose mine... 50
Moore, E. S......172, 174
Reports by :—
Iron Range N. of Round lake......154-162
Limonite on English river......180-195
Onaman Iron range... 196
Moore, Samuel... 92
Moose.
Nipigon Lake dist... 179
Onaman Iron range... 200
Moose Horn Mines, Ltd... 126
Moose Horn silver mine......49, 126
Moose Mountain iron mine......25, 89
Moraines.
Black Sturgeon lake... 173
Niblock, near... 183
Nipigon Lake dist......141, 142, 160
Onaman Iron range......203, 204, 208, 232, 253
photos......250, 251
Morgan, J. W......47, 48, 189
Morrison silver mine... 111
Mosher Bros......268, 270, 281
Mother Lode Mg Co... 126
Mount Etna lavas... 240
Mount Royal Cobalt Silver Mg. Co... 44
Mount Royal Consolidated Mines, Ltd... 43
Mowat tp... 50
Mud river, L. Nipigon. *See* Pikitigushi river.
Mud river, Pic river.
Clay on, photo... 152
Muggley Concentrators, Ltd......12, 111
Munro Mines, Ltd... 43
Munro tp... 52
Munsell, Eugene & Co... 140
Murphy, A. J... 124
Murray silver mine... 50
Muskegs.
Abitibi dist......266, 267, 282
English River dist... 191
James bay... 293
Lake Ojibway... 284
Long lake, Th. B.d., west of... 291
Nipigon Lake dist......146, 148, 155
Onaman Iron range......200, 204
Shebandowan, near... 183
Muskoka dist.
Limonite in... 195
Taxable areas in... 42
Muskrat.
Onaman Iron range... 201
Mutual Natural Gas Co... 35

Nancy Helen silver mine.
Accidents......62, 69
Notes on... 111
Producing... 10
Production... 15
Nascioli, Dominick......63, 70
National Portland Cement Co... 29
Natural gas.
Industry... 35
Statistics......6, 9

PAGE.

Naughton, Ont.
Quartz quarry near 86
" accidents 56, 69
Neelands, E V 106
Nesbitt, Dr. W. Beattie 118
Nesbitt and Crompton 124
Net lake 133
New Brunswick.
Limonite 186, 195
New Caledonia.
Nickel 24
New Liskeard 289
New Ontario Finance Syndicate 43
Niblock, Ont.
Bog iron near 180, 183, 188
Claims near, map 182
photo 185
Moraine near 183
Photo of concretions in ore 187
Niccolite.
Elk Lake dist 16
Haileybury silver mine 123
Nichols Chemical Co 32
Nickel.
Clergue tp 50
Cobalt 13
Dundonald tp 23, 24, 50
Report on mining 19, 21
Statistics 5, 6, 8, 23
Sudbury dist 86-89
Nickerson, R. B 79
Nicol tp 48, 95
Night hawk lake 268, 288, 289
Night-hawk river 288
Nipigon lake.
Altitude 177
Boulders on, photo 142
Col northeast of 286
Canoes on, photo 199
Diabase in, photo 160
Lacustrine beds north of 292
Photo of portion 161
Pleistocene deposits near 250
Nipigon Lake dist.
*See* also Onaman Iron range.
Reports on iron in 141-179
Nipigon river 177
Nipissing Diamond Drilling Co 43
Nipissing mining dist.
Revenue 38
Taxable areas in 42
Nipissing Reduction Co 12, 13, 43
Nipissing silver mine.
Accidents 63, 64, 69
Dividends 17
Power from 107, 109
Producing 10
Production 15
Report on 111-113
Niven, Alexander 47, 288
Nonwatin lake.
Description and geology; iron near 164-170
Nonwatin river 165
Nonwatinose lake 164, 165
Norfolk co.
Limonite in 194, 195
Norfolk Gas Co 44
Norfolk gas-field 35
Norite 24
Normandale, Ont 195
North Bay, Ont 289
North Burgess tp 140
North Carolina.
Analysis of dunite and peridotite from 274
Corundum in 275
North Dorchester tp 38
North-Lanark Marble and Granite Quarries Co 44
North shore, L. Superior.
Copper mining on 84, 89
Northern Customs Concentrators, Ltd 12, 111
Northern Development Co. *See* Paymaster gold mine.
Northern Discovery Co 43
Northern Pyrites Co 32
Northern Pyrites mine. *See* Vermilion pyrites mine.
Northern Star Mining and Development Co 44
Northland Mg. Co 32, 65, 69, 132
Northland pyrites mine 132
Norwalk gold mine 92, 93
Norwalk Mg. Co 92
Nova Scotia Cement and Plaster Co 45
Nova Scotia Mining Co 115

PAGE

Nova Scotia silver mine.
Accidents 65, 69
Concentrating at 13
Producing; production 10, 15
Report on, and photo of 113, 114
Nugget silver mine 114
Nyholm, Wm 57, 69

Oats.
Abitibi area 257
O'Brien silver mine 94
Accidents 65, 69
Close corporation 16
Concentrating at 13
Govt. revenue from 39
Production 15
Photo 97
Report on 114
Ochre, yellow.
Little Bear lakes 188
Ogilvie, Morley 130
Ogilvie, William 265
Ogoki river 293
Oil.
Industry 33-35
Statistics 6, 9
Ojibway lake (glacial) 144
Report by Coleman 284-293
Okikodosik river 279
Olden iron mine 134
Oliphant Oil & Gas Co 44
Oliver Ferry 137
Oliver lake 176, 176
Onaman Iron range.
Report by Moore 196
Onaping river 287
Oneida Lime Co 44
Onondaga formation 34
Ontario.
Drift in, classification and nomenclature 294-297
Mines of 78-140
Mineral statistics 5-54
Ontario Copper and Smelting Co 45
Ontario Dev. and Mg. Co 44
Ontario Dev. Co 44
Ontario Gas and Oil Fields 44
Ontario Iron and Steel Co 26, 35
Ontario Limestone and Clay Co 44
Ontario Marble Quarries 45
Ontario People's Salt and Soda Co 33
Ontario Portland Cement Co 30
Ontario Sewer Pipe Co 29
Ontario Silica Co 46
Opasatika lake 292
Ophir Cobalt Mines, Ltd 44
Ore Reduction Co 115
Osman, Andrew 59, 70
Otisse-Curry Consolidated Silver Mines.
Capital and date of charter 44
Installing machinery 49
Work by 127
Otisse Mining Co.
Capital and date of charter 44
Installing machinery 49
Work by 127
Photo of mine 127
Ott Brick and Tile Manufacturing Co 45
Ottawa.
Mica industry in 139, 140
Ottawa river.
Glaciation on 284, 287, 296
Marine fossils on 293
Otter head, Black Sturgeon lake 178
Otto Lake Mg. Co 44
Otty Lake mica mine 32
Owen Sound Portland Cement Co 30
Oxford Oil and Gas Co 44

Palladium statistics 8
Pan Silver Mining Co 45, 103
Pardee, Ont 287
Park, Hugh 113
Parkhill Salt Co 33
Parks, Dr. W. A 288, 292
Parry Sound Copper Co 50
Parry Sound mining dist.
Revenue 38, 47
Recorder's report 60
Taxable areas in 42
Parsons, A. L 150, 153
Partridge.
Onaman Iron Range 201
Paterson silver mine 66, 69, 116

PAGE.
Patterson, Robert ..... 130
Paymaster gold mine ....79, 81
Pearce gold mine ..... 133
Peat.
Abitibi dist ..267, 283
English River dist ..... 184
North Dorchester tp ..... 38
Statistics ....6, 9
Peerless Brick and Tile Co ..... 44
Pegmatite
Haystack mt ..... 162
Larder lake ..... 270
Long lake, Nipigon dist ..... 144
Pegutchewan lake ..... 151
Penage lake ..... 49
Peneplains.
Onaman Iron range ..... 202-204, 207, 208
Pennsylvania Lumber & Mineral Co ..... 44
Pennsylvania Smelting Co ..... 13
Peridotite.
Abitibi dist ..... 273
" analysis and notes ..... 274, 275
Perth, Ont.
Mica mining near ..... 140
Peterson lake.
Boring on ..... 50, 51
Silver mining on ..... 107, 109, 113, 118-121
Peterson Lake silver mine
Accidents ..... 66, 69
Notes on ..... 115
Producing ..... 10
Production ..... 15
Petrography.
Acid eruptives ..... 223
Basic rocks ..... 219
Diabase ..... 249
Diorite ..... 157
Garnetiferous-schist ..... 215
Gneiss ..... 246
Hornblende granite ..... 278
Hornblende porphyry ..... 246
Iron formation ..... 233-239, 256
Limonite ..... 187, 188
Mica schist ..... 278
Peridotite ..... 273
Quartz-diabase ..... 280
Tuffs, etc ..... 229-231
Petrolea oil-field ..... 33, 34
Petroleum. *See* Oil.
Phanerite ..... 272
Phillips, D ..... 135
Phœnix Oil & Gas Co ..... 45
Phosphate of Lime. *See* Apatite.
Phosphorus for fertilizer ..... 37
Phyllites
Larder lake ..... 270
Onaman Iron range ..... 235
Physiography.
English River dist ..... 184
Onaman Iron range ..... 202
Pic river.
Canoe route on ..... 141
Glacial deposits near ..... 286
Indians on, photo ..... 171
Notes and photos ..... 149-153
*Picea alba.* *See* Spruce, white
*Picea nigra.* *See* Spruce, black
Pickerel.
Onaman Iron range ..... 200
Pickerel branch, French river ..... 50
Pig iron. *See* Iron.
Pigeon lake, Montreal river ..... 274
Pike.
Onaman Iron range ..... 200
Pikitigushi river ..... 154, 155
Pine, Banksian.
Nipigon lake, north of ..... 157
Onaman Iron range ..... 200
Pine, red and white
Nipigon Lake dist ..... 179
Pine lake, Th.B.D ..... 291
Pioneer Exploration Co ..... 45
Pirsson, Prof. L. V ..... 217
Pisidium ..... 153
Pitcher plant.
Onaman Iron range ..... 200
*Planorbis.*
Pic river ..... 153
Plants.
Forming bog iron ore ..... 193
Platinum.
In peridotite rocks ..... 275
Statistics ..... 8

PAGE.
Pleistocene deposits.
Abitibi dist ..... 281-283
Classification and nomenclature ..... 294-297
Lake Ojibway ..... 284-293
Onaman Iron range ..... 208, 250-252
Pic river ..... 150-153
Pikitigushi river ..... 155
Round Lake dist ..... 160, 161
Plumbago. *See* Graphite.
Point Anne Quarries, Ltd ..... 44
*Poniobasis* ..... 153
Pontiac Mining Co ..... 115
Pontiac Silver Mining Co ..... 45
Poplar.
Abitibi dist ..... 267
Nipigon lake, north of ..... 157
Onaman Iron range ..... 200
Porcupine silver mine ..... 12, 84
Port Arthur, Ont.
Iron industry near ..... 79
Silver mining near ..... 84
Port Arthur mining div ..... 47, 48
Mining in ..... 9, 11, 12
Port Colborne-Welland Natural Gas Co ..... 35
Port Elmsley, Ont ..... 137-139
Portland cement. *See* Cement.
Post Tertiary. *See* Pleistocene.
Pottery.
Industry ..... 31
Statistics ..... 6, 9
Powell, William ..... 107
Preston, W. A ..... 11, 12
Prickly pear.
Organic action of, on lavas ..... 240
Princess silver mine ..... 15, 115
Prodaniuk, Iwan ..... 57, 69
Producer's Natural Gas Co ..... 36
Progress silver mine ..... 116
Proudfoot fraction ..... 124
Proudfoot tp ..... 50
Prout, J. W ..... 111
Provincial Natural Gas and Fuel Co ..... 35
Provincial silver mine.
Gold revenue from ..... 38, 42
Producing ..... 10
Report on ..... 115
Prudential Mines, Ltd ..... 44
Pulpwood.
Abitibi dist ..... 267
Long lake, Nipigon dist ..... 149
Pyrrhotite.
Dundonald tp ..... 24
Onaman Iron range ..... 217
Shaft island ..... 269

Quaker City-Cobalt Mines ..... 44
Quartz.
Naughton quarry ..... 86
Quartz-diabase ..... 280
Quartz-porphyry ..... 225
Quartzite.
Dundonald tp ..... 23
Quebec prov.
Glaciation in ..... 287, 289, 292
Limonite in ..... 186, 188, 195, 240
Queen Alexandra silver mine ..... 116
Queensboro, Ont.
Pyrites mining near ..... 136
Queenston, Ont ..... 30
Quelne, J ..... 64, 70
Quinze lake, Que ..... 292

Rabbit Mountain silver mine ..... 12
Radishes.
Onaman Iron range ..... 200
Radnor Forges, Que ..... 195
Ragged Chute, Montreal river ..... 94
Rainfall.
Onaman Iron range ..... 200
Rainy lake ..... 284
Rainy River dist.
Farm lands in ..... 284
Gold in ..... 52
Taxable area in ..... 42
Ramner, Otto ..... 63, 70
"Ranger" S. S ..... 264
Rankin iron mine ..... 134, 135
Ransford, John ..... 33
Rat Root river ..... 177
Raven Lake Mining and Development Co ..... 45

PAGE.
Rawhide Mines, Ltd. ... ..... 45
Red Jacket silver mines... 44, 111
Red Paint lake.
Drift pebbles on ... 252
Notes on ... 204
Travertine on ... 208, 252, 253
Red Paint river.
Iron range near, report by Moore ... 196-253
"Col" at ... 286
Red portage, Red Paint river ... 199, 215, 216, 233
Red Rock silver mine ... 15, 105
Reddick Larder Lake Mines, Ltd ... 130, 131
Regal Mining Co ... 45
Reid, F. D ... 101
Renfrew mining dist.
Revenue ... 38
Rennie, James ... 99
Revenue from mines ... 38
Rhyolites.
Onaman Iron range ... 204-211, 217, 222, 226, 227, 241, 245, 253
microphotos ... 242, 248
petrography ... 220-225
photo ... 244
Woman River Iron range ... 255, 259-261
Rib lake ... 65, 70
Rib lake pyrites mine. *See* Harris pyrites mine.
Richardson feldspar mine ... 136, 137
Richardson gold mine ... 132
Richardson iron mine ... 134
Richardson (Chatham) oil-fields ... 34
Right-of-Way silver mine.
Accidents ... 66, 69
Dividends ... 17
Photos ... 97, 117
Producing and production ... 10, 15
Report ... 116
Rioux, Alphonse ... 67, 70
R L 432 claim ... 125
Roads.
Timagami dist ... 16
Robbins, P. A ... 110
Roche, E. K ... 50, 51
Rochester, D. B ... 104
Rochester silver mine ... 116
Rogers, R. P ... 99
Roi, Thomas ... 63, 70
Roland lake ... 175, 176
Romney oil-field ... 33, 34
Rondeau, Ont ... 194
Rose Gold and Silver Mining Co ... 45
Ross-Ballard Mining Co ... 45
Rossiter, E. J ... 133
Rossport, Ont.
Coal near ... 49
Roswell Silver Mg. Co ... 44
Rothschild silver mine ... 50, 51
Rothwell, T. E ... 54
Round lake, Nipigon dist.
Iron range north of ... 154-162
Routes.
Abitibi lake from Matheson ... 263, 264
Black Sturgeon lake from Lake Superior ... 163
Gowganda ... 95
Maple Mt. area ... 128
Nipigon Lake dist ... 141, 149
Woman River Iron range ... 254
Royalties ... 38
Russell, Wm ... 58, 70
Rust lake ... 254
Ryerson, G. S ... 130

Safety catches ... 75
St. Anthony gold mine ... 79, 82, 119
St. Anthony Mining Co ... 115
St. Catharines Brick & Tile Co ... 45
St. Clair lake ... 33
St. Clair Oil Company ... 45
St. John's Temagami Gold & Silver Mining Co ... 45
St Lawrence Cobalt Mg. Co ... 66, 69
St. Lawrence river.
Glaciation on ... 287, 296
St. Marie lake ... 199, 215, 216
St. Maurice, Que ... 195
Salt.
Industry ... 33
Statistics ... 6, 9
Sand lake, Bear river ... 180
Sandhill falls, Pic river ... 151, 153
Sandow, R ... 116
Sapola, August ... 55, 69
Saravana, Stefan ... 62, 70

PAGE.
Saugeen clay.
Abitibi dist ... 267, 272, 281-283
Description of ... 296
Position of, geologically ... 294
Sault Ste. Marie mining div ... 47, 49
Sauvé, Joseph ... 133
Savage silver mine ... 117
Saxicava sand.
Eastern Canada ... 294
Scandinavia ... 24
Scarboro Heights ... 295
Scott, John ... 37
Scott, N. O ... 115, 118
Scully silver loc ... 40
Sebastine, Bosati ... 63, 70
Seelye, R. W ... 91
Seine river ... 9
Selkirk Gas and Oil Co ... 36
Sellwood, Ont ... 95
Selwyn lake, English river ... 180
Serpentine.
Abitibi dist ... 273
Dundonald tp ... 24
Seven-mile point, Long lake ... 144
Sewer pipe.
Industry ... 29
Statistics ... 6, 9
Sextant rapid, Abitibi river ... 293
Seymour, Algernon P ... 105
Shaft accidents ... 74, 75
Shaft island, Abitibi lake.
Gold mining on ... 267, 269, 281
Shamrock Silver Co ... 119
Shamrock silver mine.
Boring in ... 50, 51
Sharp, A ... 89
Sharpe Lake Mines ... 44
Shawanaga tp ... 50
Shebandowan, Ont ... 183
Shedden tp ... 51
Short, H. H ... 121
Shovells, Wm ... 103
Shuniah silver mine ... 12
Shutt, W. H ... 126
Silver.
Cobalt dist ... 96-113
(*See also* Cobalt, Ont.)
Companies floated ... 43-45
Elk Lake area ... 125-127
Gowganda area ... 95
Mining ... 10-17, 46-50
Montreal River dist ... 95
South Lorrain tp ... 16, 39, 50, 94, 123
Timiskaming dist ... 94
Statistics ... 5-8
Silver Alliance Mines ... 44
Silver Bar silver mine ... 15
Silver Cliff silver mine ... 10, 15, 117
Silver Crescent Mg. Co ... 44
Silver Cross silver mine ... 119
Silver Elk Mines ... 44
Silver Hill silver mine ... 108
Silver Islet silver mine ... 11, 12
Silver Lake, Ont ... 49
Silver lake, Mickle tp ... 127
Silver Lake Mg. Co ... 44
Silver Leaf silver mine ... 10, 15, 102, 119
Silver Lode Mines, Ltd ... 44
Silver Maple Mines, Ltd ... 45
Silver Mountain silver mine ... 12
Silver Queen mica mine ... 140
Silver Queen silver mine. *See* Cobalt Silver Queen.
Silvers, Ltd ... 44
Similkameen dist., B.C ... 275
Sinclair, P. L. S. Duncan ... 47
Skill, Albert ... 47, 49
Slate.
Banded with jasper, notes and photo ... 234
Onaman Iron range, microphotos ... 221
petrography ... 235, 237
Smaltite.
Elk Lake dist ... 16
Haileybury silver mine ... 123
Smelters and Smelting.
Electric ... 26, 27
Iron ore ... 25, 26
Nickel ... 21, 25
Parry Sound dist., wanted ... 50
Sudbury ... 86
Thessalon ... 84
Victoria Mines ... 88
Smith, A. A ... 96

PAGE.

Smith, Alex. H.... 105
Smith, Edward.... 140
Smith, George T.... 47, 49
Smith, Terry.... 140
Smith and Grover.... 123
Smith mica mine.... 140
Smiths Falls, Ont.... 37
Smith's Falls Pressed Brick Co.... 45
Smyth, Ont. (Elk Lake).
Government office at.... 48, 49
Road from.... 18
Townsite at.... 16
Smyth tp.... 48, 125
Snedeker, C. C.... 133
Snider, Wm.... 84
Soari, Angus.... 63, 70
Sodalite statistics.... 9
Sohier, R.... 119
Soil. *See* Agricultural land.
Sonora Mining Co.... 44
Soo Copper Co.... 45
South bay, Abitibi lake.... 270
South bay, Black Sturgeon lake.... 177
South-Lorrain Development Co.... 45
South Lorrain tp.
Silver in.... 16, 39, 50, 94, 123
Spanish river.... 287
Speight, T. B.... 266
Spencer, Dr. J. W.... 286
Sphagnum moss.
Onaman Iron range.... 200
Sphalerite. *See* Zinc-blende.
Spring, W.... 194
Spruce.
Abitibi dist.... 267
Nipigon Lake dist.... 157, 179
Spruce black
Onaman Iron range.... 200
Spruce, white
Onaman Iron range.... 200
Spurr, J.... 239
Steel.
Industry.... 25
Statistics.... 8
Squirrel, flying
Onaman Iron range.... 201
Standard Cobalt Mines, Ltd.... 98, 100
Standard Cobalt silver mine.... 10, 12
Staples oil-field.... 34
Statistics.
Method of computing.... 7
Report by Gibson.... 5-54
Sterling Gas Co.... 35
Sterling mine.... 132, 133
Stevens, W. M.... 134
Stevenson silver mine.... 128
Stobie nickel mine.... 21
Stoness, J. M.... 32
Stoness and Kent.... 140
Strathcona Nickel Mines.... 44
Strathcona Silver Mg. Co.... 119
Straivinski, Jan.... 57, 69
Strawberry, wild
Onaman, Iron range.... 200
Svanson, J. L.... 57, 69
Sturgeon lake, R. R. d.
Gold mining on.... 9, 79, 81, 82
*Succinea*.
Pic river.... 153
Sudbury, Ont.
Quartz mining near.... 86
Sudbury mining dist.
Revenue.... 38, 41, 47
Report on.... 49, 84-89
Taxable areas in.... 42
Statistics.... 7, 19
Suilga Wasyl.... 57, 69
Sulphide, Ont.... 32
Sulphide pyrites mine.... 135
Sulphuric acid industry.... 32
Sun Portland Cement Co.... 30
Superior Portland Cement Co.... 29
Susquehanna silver mine.... 119
Swastika Mining Co.... 45
Sweden.
Bog iron ore in.... 192, 195, 240
Syracuse Mining and Development Co.... 45

Taggart mica mine.... 32
Talc.
Madoc tp.... 38, 137, 138
Statistics.... 6, 9

PAGE.

Tamarack.
Onaman Iron range.... 200
Taylor, F. B.... 286
Taylor, Rex.... 114
Taylor Hydraulic Compressed Air Co.... 94
T B 3 and 196 silver locs.... 51
Temagami-Cobalt Mines.... 44, 133
Temagami Forest Reserve.
Mining in.... 19, 132, 133
area in.... 47
permits.... 39
Temagami Gold Reefs Co.
Accident at mine of.... 67, 69
Capital and date of charter.... 44
Work by.... 133
Temiscaming and Hudson Bay silver mine.
Dividends from.... 17
Govt. revenue from.... 39, 40
Notes and photos.... 120-122
Producing.... 10
Production.... 15
Temiscamingue silver mine.... 10, 15, 98
Temiskaming and N. O. R'y.
Lake deposits on.... 289, 290
Temiskaming Cobalt silver mine.... 15
Temiskaming Mining Co.... 17
Temiskaming mining div.... 47, 49
Mining in.... 94-96
Temiskaming lake.
Altitude.... 293
Glaciation on and near.... 287-289, 292
Terraces.
Abitibi dist.... 266
Black Sturgeon river.... 164
Glacial Lakes reg.... 286-294
Nipigon Lake dist.... 141, 142, 151-155, 160, 179
Tarrill, Capt.... 123
Tett, J. P. and Bros.... 32
Thamesville oil-field.... 33, 34
The Mother-Lode Mg. Co.
Capital and date of charter.... 44
Installing machinery.... 49
Therien, Rosario.... 54, 69
Thessalon, Ont.... 84
Thompson, James.... 140
Thomson, George.... 64, 70
Thorne, F. M.... 119
Thorold, Ont.... 31
Thow, George.... 81
Three A silver mine.... 12
*Thuja occidentalis*. *See* Cedar.
Thunder Bay mining dist.
Revenue.... 38
Taxable areas in.... 42
Thunder Bay silver mine.... 12
Tilbury oil-field.... 33, 34
Tile statistics.... 6, 9
Timber. *See* Trees.
Timiskaming. *See* Temiskaming.
Titan Montreal River Mines.... 45
Titanium.
In iron ores.... 27
Toledo Silver Mines.... 45
Tomatoes.
Abitibi dist.... 267
Topography.
Abitibi dist.... 266
Onaman Iron range.... 202-204
Toronto.
Gas rates.... 36
Hudson shale at.... 295
Toronto and Niagara Carbide Co.... 45
Toronto-Brazilian Diamond and Gold Dredging Co. 45
Toronto Indestructible Brick Co.... 45
Torrance, T. H.... 47, 49
Tourmaline.
Onaman Iron range.... 215-218, 225
microphoto.... 242
Toyne, John.... 37
TR gold loc.... 133
Transcontinental Silver Mines.... 45
Transvaal.
Accidents in mines.... 73
Catches do.... 75
Trap lake, Sturgeon River reg.... 158
Travertine.
Onaman Iron range.... 208
Red Paint lake.... 252, 253
Trees.
Abitibi dist.... 267
Nipigon Lake dist.... 149, 157, 179
Onaman Iron range.... 200
Timagami Forest Reserve.... 19

PAGE.
Trethewey, Richard ..... 11
Trethewey silver mine.
Accidents ..... 67-69
Dividends ..... 17
Notes ..... 120, 121
Producing ..... 10
Production ..... 15
Trinity-Cobalt Mining Corporation ..... 45
Trinity silver mine ..... 121
Trombley iron claims ..... 199, 215, 216
Trout, brook.
Onaman Iron range ..... 200
Trout lake, Nipigon dist ..... 142
Truax tp ..... 48
Tryjomak, Makxym ..... 58, 70
Tudhope tp.
Silver mining in ..... 48, 50, 125, 126
Turnbull siding ..... 287
Turner, A. P ..... 86
Turner, N. L ..... 186, 188, 214, 243
Report by, on Govt. Assay office ..... 52
Turnips ..... 200
Tweed, Ont ..... 135
Twin City Coal Co ..... 45
Twin falls, Abitibi river ..... 264
Tyrrell, J. B ..... 284, 298

Ulrica Mines Co ..... 45
*Unio.*
Pic river ..... 153
Union Pacific Cobalt Mines, Ltd ..... 121
Union Pacific Mining Co ..... 115
Union Sulphur Company ..... 45
United Gas Co ..... 35
United Oil Fields ..... 45
United States.
Accidents in mines ..... 71, 72
Cobalt silver shipments to ..... 10
Silver production ..... 9
United States Metal and Refining Co ..... 13
University silver mine.
Air power from ..... 114
Notes ..... 121
Production ..... 15
Uno Park ..... 289
Unum Cobalt Mining Co ..... 45
Upham, Warren ..... 284
Upper Manitou lake.
Gold mining in region of ..... 79-81

*Valvata.*
Pic river ..... 153
Van Hise, C. R ..... 239, 240, 256, 257, 276
Van Nostrand tp ..... 95
Vankleek galena mine ..... 135
Vegetation.
Onaman Iron range ..... 200
*See also* Agricultural land.
Vermilion dist., Minn ..... 256
Vermilion pyrites mine.
Notes and photo ..... 83, 84
Vermilion river.
Glacial deposits on ..... 287, 292
Verner Silver Mining and Development Co ..... 45
Victoria nickel mine ..... 23
Electric power at ..... 84
Notes ..... 88
Victoria silver-cobalt mine ..... 67, 69
Accident at ..... 58, 59, 70
Notes ..... 122
Production ..... 15
Victory gold mine ..... 81
Ville Marie, Que ..... 289
Violet gold mine ..... 81
Violet silver mine.
Production ..... 15
Work on ..... 122
Vipond Mining Co ..... 45
Vogt, W ..... 273
Volcanic Oil and Gas Co ..... 36
Vulcan Gold Mines ..... 45

Wabagesik fall, Vermilion river ..... 25
Wabisbonia Cobalt Mining Co ..... 45
Wahnapitae. *See* Wanapitei.
Wakefield, W ..... 130
Wako, Ont ..... 82

PAGE.
Walkerton, Ont ..... 283
Wallaceburg gas rates ..... 36
Wallingford Mining and Mica Co ..... 140
Walsh Forwarding Co ..... 264
Waltham-Ontario Oil Producing Co ..... 45
Wanapitei river ..... 287, 292
Warren lake (glacial) ..... 251, 284, 287, 295
Warrington, John ..... 68, 70
Watash Cobalt mines ..... 45
Waterpower.
High falls, Spanish river ..... 25, 92, 93
Hound chute ..... 94
Madawaska river ..... 139
Ragged chute ..... 94
Wabageshik falls ..... 25
Watson, R. B ..... 109, 113
Watts silver mine ..... 107
Wawa tuffs ..... 233
Webb, J ..... 84
Welland County Lime Works ..... 35
Welland gas-field ..... 35, 41
Wellington, S ..... 137
Wells, J. Walter ..... 31
Wendigokan Lake region ..... 208, 233, 234
West Coleman Silver Mines ..... 45
West End silver mines ..... 84
Western Canada Flour Mills Co ..... 33
Western Ontario Portland Cement Co ..... 30
Western Salt Co ..... 33
Wettlaufer Lorrain Silver Mines, Ltd.
Capital and date of charter ..... 45
Machinery installed by ..... 50
Work by ..... 124, 125
Whalen, F. A ..... 62, 70
Wheat
Abitibi area ..... 267
Whistle nickel mine ..... 89
White, H. T ..... 273
White, James ..... 293
White, W. J ..... 96, 122
White Bros ..... 95, 128
White river, Larder Lake dist ..... 289
"White-dykes" ..... 279
White Otter falls, Pic river ..... 153
White Silver Mining Co ..... 15
Whitefish.
Onaman Iron range ..... 200
White's Bonanza Lode Mining Co ..... 45
Whitson tp ..... 95
Wilberforce, Ont ..... 137
Wilbur iron mine ..... 25, 68, 69
Wiley, F. S ..... 11, 12, 163
Willet tp ..... 125
Willmott, Arthur B ..... 233, 239
Willows.
Pic river ..... 153
Wilson, D. A. W. G ..... 163, 176, 202, 295
Wilson, J. E ..... 132
Wilson, W. J ..... 293
Wiltsey silver mine ..... 125
Winchell, H. V ..... 239
Winchell, N. H ..... 239
Windsor hotel, Gowganda ..... 21, 26
Winter Camp iron claims.
Diamond drill at, photo ..... 245
Fault planes on ..... 210
Greenstone in ..... 219, 228
Iron formation in ..... 231, 232
Wisconsin ice sheet ..... 295-297
Wishart, Mr ..... 123
Wolf.
Onaman Iron range ..... 200
Woman River iron range.
Report by R. C. Allan ..... 254-262
Woods silver mine ..... 125
Worthington nickel mine ..... 89
WS 1-12 iron locs ..... 254-260

Yellow lake ..... 180-183
Young, Cyril T ..... 115, 123
Young, George ..... 107
Young, Jacob M ..... 101

Zinc and zincblende.
Madoc tp ..... 135
Shaft island ..... 269
Statistics ..... 8

# EIGHTEENTH ANNUAL REPORT

OF THE

# BUREAU OF MINES, 1908

VOL. XVIII. PART II.

CONTENTS

1. THE GOWGANDA AND MILLER LAKES SILVER AREA.
2. THE SOUTH LORRAIN SILVER AREA.

By A. G. BURROWS.

PRINTED BY ORDER OF THE LEGISLATIVE ASSEMBLY OF ONTARIO.

TORONTO:
Printed and Published by L. K. CAMERON, Printer to the King's Most Excellent Majesty
1909

# CONTENTS

PAGE.

THE GOWGANDA AND MILLER LAKES SILVER AREA .... 1-21
Situation and Means of Access .... 2
Topography .... 3
Classification of the rocks .... 4
Post-Middle Huronian diabase .... 7
Huronian .... 10
Laurentian .... 10
Keewatin .... 11
Altered feldspar porphyry .... 12
Horneblende schist and amphibolite .... 12
Porphyry .... 12
Working properties .... 12
To the northwest of Miller lake .... 12
Properties west of Gowganda lake .... 16
On Leroy lake .... 20
Conclusions .... 20

SOUTH LORRAIN SILVER AREA .... 21-31
Topography .... 21
Classification of rocks .... 22
Glacial and recent .... 23
Diabase (post-Middle Huronian) .... 23
Contact with the Huronian .... 24
Huronian .... 24
Greywacké .... 24
Quartzite and Arkose .... 24
Laurentian .... 25
Keewatin .... 25
Keewatin west of Point Fine .... 26
Discoveries .... 27

WARWICK BRO'S & RUTTER, Limited, Printers,
TORONTO.

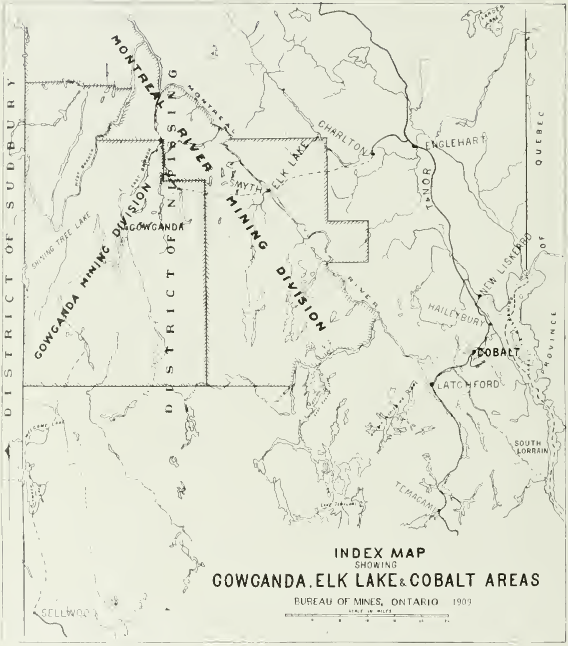
## ILLUSTRATIONS

PAGE.

The Post Office, Gowganda, April, 1909 .......... 1
Charlton depot, terminus of branch line of T. & N. O. R. from Englehart, March, 1909 .......... 2
On the Charlton-Gowganda winter road, first roadhouse west of Silver lake, April, 1909 .......... 3
A Winter scene on the Charlton-Gowganda road .......... 4
On the Charlton-Gowganda road. An open spot on Lost Lake .......... 5
Winter road across Gowganda lake, with the town in the distance, April, 1909 .......... 5
A street scene in Gowganda, March, 1909 .......... 6
A street in Gowganda, April, 1909 .......... 6
Dog team on Gowganda lake .......... 7
A load for Gowganda .......... 8
Contact of Laurentian and Huronian, east shore of Bloom lake, (G) granite, (C) angular and rounded fragments of granite, (Q) quartzite .......... 9
Contact of Huronian slate (H) and Post-Middle Huronian diabase (D), Bulsh Lake .......... 9
Granite (G) intruded by Post-Middle Huronian diabase (D), south of Bloom lake .......... 10
Keewatin (K) intruded by diabase (D) east of Cartwright's camp, Everett lake .......... 11
Open cut Blackburn claim, northwest of Miller lake, April, 1909 .......... 13
Mining machinery, Boyd-Gordon, Gowganda lake, April, 1909 .......... 17
Camp at Boyd-Gordon, Gowganda lake, April, 1909 .......... 17
Open cut, Boyd-Gordon, shaft in background, April, 1909 .......... 18
No. 1 vein, Mann mines, Gowganda lake, April, 1909 .......... 19
Mining machinery, Reeve-Dobie, Gowganda lake, April, 1909 .......... 20
"666" on Lake Temiskaming, at the end of the Keeley mine road, July, 1908 .......... 21
Prospectors at Loon lake, South Lorrain, July, 1908 .......... 22
Overlooking Lake Temiskaming from hill south of "666," South Lorrain .......... 23
A scene on Lake Temiskaming, showing landing place in South Lorrain .......... 26
A vein showing in pit on the Wettlaufer property, South Lorrain, October, 1908 .......... 27
Horse whim Haileybury Silver Mining Co., South Lorrain, 1908 .......... 28
Old timber road. South Lorrain .......... 29
The Notch, near mouth of Montreal river .......... 30

## MAPS

Index map showing Gowganda, Elk Lake and Cobalt areas .......... Frontispiece
Plan of Surveyed Claims in the vicinity of Gowganda and Miller Lakes—Scale, 1 mile = 1 inch .......... 14- 15
Map of part of Lorrain township and South Lorrain, District of Nipissing, Ontario. Geologically colored—Scale, 1 mile=1 inch.
Map of the Gowganda, Miller and Elk Lake areas (Montreal River-Temagami Forest Reserve) District of Nipissing (geologically colored)—Scale, 1 mile = 1 inch.



DISTRICT OF SUDBURY
MONTREAL RIVER MINING DIVISION
GOWGANDA MINING DIVISION
DISTRICT OF NIPISSING
GOWGANDA
SHINING TREE LAKE
SMYTH
ELK LAKE
CHARLTON
ENGLEHART
T. & N. O. R.
MONTREAL
RIVER
NEW LISKEARD
HAILEYBURY
COBALT
LATCHFORD
SOUTH LORRAIN
TEMAGAMI
PROVINCE OF QUEBEC
SELLWOOD
INDEX MAP
SHOWING
GOWGANDA, ELK LAKE & COBALT AREAS
BUREAU OF MINES, ONTARIO 1909

# The Gowganda and Miller Lakes Silver Area

By A. G. Burrows

Late in July, 1908, the writer was instructed by the Provincial Geologist to proceed to the newly found silver area in the vicinity of Miller lake and examine it geologically. Mr. W. F. Battersby and Mr. G. H. Lloyd acted as assistants and rendered efficient service.

After the promising areas in the vicinity of Elk lake, on the Montreal river, had been fairly well staked, prospectors pushed farther to the north and west, seeking other areas of promising rocks. During the summer of 1907, a belt of diabase was discovered to the west of Bloom lake, and extending south by Wigwam, Lost and Calcite lakes and north toward the East branch of the Montreal river. Smaltite and its associated bloom were found on a number of claims in that year, but very little indication of native silver. In the following winter and spring, discoveries of native silver were made to the southwest of Leroy lake on the Leroy claims, and to the northwest of Miller lake. During the summer of 1908, native silver was found on several claims around Bloom


The Post Office, Gowganda, April 1909.

lake and between this lake and Miller lake. The most important finds, however, were those in the vicinity of Miller lake, where silver occurring in rich shoots, was found in the massive form on the Gates, Blackburn and Bonsall properties.

Later in the summer other promising finds were made on the Mann, Boyd-Gordon and other claims to the west of the northwest arm of Gowganda lake, and west of the south end of the lake on the McIntosh-McLaughlin and Reeve-Dobie claims. Unfortunately there was no opportunity to examine the country to the west of Gowganda lake

before the snow came. Following these discoveries there was a rush to the Gowganda area, and hundreds of claims have been staked to the west, towards Shining Tree lake, which is on the boundary of Nipissing and Algoma. Much staking was also done to the south of Calcite lake—in Lawson, Corkill and adjoining townships.

### Situation and Means of Access

Gowganda lake, which may be called the centre of this new mineralized area, is almost directly west and a little south of the township of James, which is on the Montreal river. It is part of the water system of the East branch, a tributary of the Montreal river. The lake lies along the line of the townships of Milner and Nicol. A townsite has been established on the northeast bay of the lake and is known as Gowganda. Surveyed in February the town now has a population of several hundred.

The district is reached during the winter by two roads, one from Sellwood the present terminus, north of Sudbury, of the Canadian Northern railway, distant about 70 miles from Gowganda, and another from Charlton, on the branch line from Englehart on the Temiskaming and Northern Ontario railway, a distance of 54 miles. During


Charlton Depot, Terminus of branch line of T. & N. O. R. from Englehart, March 1909.

the past winter both these roads were taxed to their utmost in transporting supplies, mining machinery, etc., to the new camps At one time, it is estimated, there were 650 teams hauling freight and passengers on the Charlton road alone, and on the Sellwood road over 200 teams. On the Charlton road the freight charges were at first $2.50 per hundred pounds, but this was increased toward the end of the season to $4.50, and just before the break-up $100.00 per load was charged for the trip to Gowganda.

To meet the needs of the district a wagon road is being laid out from Elk lake to Gowganda, and this will be utilized in conjunction with the steamboat lines from Latchford to Elk lake. The steamboat route is about 50 miles in length, and in this distance three portages are made—at Pork Rapids, Flat Rapid and Mountain Chute.

The canoe route to Gowganda is by way of the Montreal river. Small gasoline launches may be utilized as far as Indian Chute, beyond which canoes must be used, following the main Montreal river to the junction of the East branch, and this latter stream directly to Gowganda. There is a shorter and more travelled route by a one and a half mile portage from the Montreal river, at a point about 12 miles above the town of Smyth, into Stony creek, and following up this stream to Stony lake and a chain of smaller lakes connected by short, rapid streams, to Portage lake. At the north end of this lake a 50-chain portage westerly brings one to the East branch. Everett, Miller and Leroy lakes are best reached by travelling south on Portage lake and following the route by way of Bloom lake. The portage routes referred to are shown on the accompanying geological map.

A good trail by way of Leroy and Miller lakes connects Lost and Gowganda lakes. Another trail, one and a half miles long, connects Miller and Everett lakes. From the west end of Everett lake a trail may be followed to Obuskong lake.

On the Charlton-Gowganda winter road, first roadhouse west of Silver Lake, April 1909.

The East branch of the Montreal river from Smoothwater lake to the main Montreal river has been described by Dr. Robt. Bell in the Report of the Geological Survey of Canada (1875-76,) and again by Mr. J. L. R. Parsons in the Report of Survey and Exploration of Northern Ontario (1900). Gowganda is called Lady Dufferin lake in Dr. Bell's report.

### Topography

The surface of this area is very rough and broken. Rocky ridges and swampy depressions are characteristic of much of the country. Over a great part of the surface there are the usual glacial and other superficial deposits, consisting chiefly of sand and gravel, which support a good growth of spruce, jack pine, poplar, birch and balsam. In limited areas there is also white and red pine. Much of the area between Lost, Wigwam and Bloom lakes and Gowganda has been partially burned over during the past year.

In the area between the west branch of the Montreal river and Long Point lake the main ridges have a north and south trend. In this distance there are several chains of lakes and streams which divide the main ridges. The water of this area flows

to the north toward the Montreal river. The chains of lakes include: (1) Gowganda, Burke, Edith and Obuskong lakes; (2) Calcite, Lost, Wigwam and Bloom lakes; (3) Long Point, Eagle, Pike, Birch and Portage lakes. The waters of the last two chains drain into the Montreal river by way of Stony lake and Stony creek.

In a general way it is also found that the diabase occurrences have their greater extension in a north and south direction.

### Classification of the Rocks

The rocks of this area include a number of types from the post-Middle Huronian to the Keewatin, and may be tabulated as follows:—

**POST-MIDDLE HURONIAN**

*Diabase*

*Igneous Contact.*

**HURONIAN**

*Quartzite, arkose, greywacke, conglomerate and slate*

*Great Unconformity.*

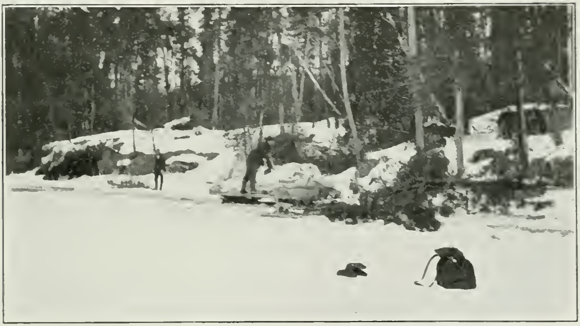
**LAURENTIAN**

*Granite, syenite, gneiss, intrusive into the Keewatin but not into the Huronian*

*Igneous Contact.*

**KEEWATIN**

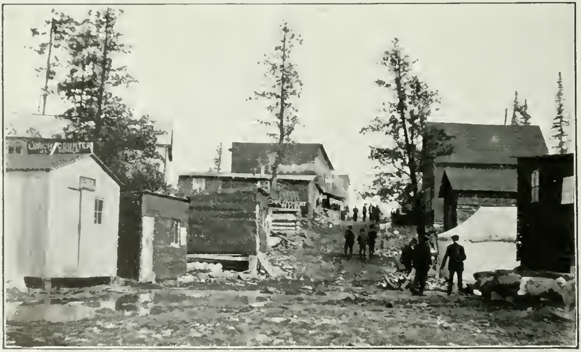
*A volcanic complex, consisting generally of altered basic igneous rocks, together with some acid porphyries.*



On the Charlton-Gowganda road. An open spot on Lost lake.

Winter road across Gowganda lake with the town in the distance, April 1909.


A street scene in Gowganda, March 1909.



A street in Gowganda, April 1909.

### Post-Middle Huronian Diabase

In the exploration of the Montreal river and Temagami Forest Reserve areas it has been found that the discoveries of native silver are confined chiefly to the diabase, unlike the area at Cobalt, where the great majority of silver finds have been made in the conglomerate. In this north country, however, it is not wise to overlook the conglomerate and Keewatin areas, for important finds have been made in these formations in the vicinity of Miller lake, and notably on the Blackburn claim, where a vein carrying smaltite and native silver has been found in the conglomerate, near a contact with the diabase. It is reported on reliable authority that native silver has been discovered in the Keewatin area immediately east of Leroy lake.

In appearance and texture the diabase of this new area is quite similar to that of Elk lake, Cobalt and South Lorrain, and all are evidently of the same age. It is usually very fresh in appearance and rather coarse-grained where the outcrop is of any extent. Where very coarse-grained it is usually called gabbro by the prospectors.

Dog team on Gowganda lake.

Much of the diabase in the extensive area to the southwest of Bloom and Wigwam lakes has the appearance of a large sill or sheet. On the southeast shore of Shanty lake the relationship with the Huronian slate is clearly seen. Along the south line of M. R. 723, the diabase lies directly on the slate with almost horizontal contact. The line of contact is hardly recognizable where the formations are fused together, but within a few feet in a vertical direction the diabase assumes its normal appearance. To the south toward Irene and Sigs lakes the diabase is elevated in a range, several hundred feet in height, but on these lakes similar slate is seen at a lower level, and it would seem that it bears a like relationship to the diabase on Shanty lake. There is no evidence of a surface flow in the diabase. South of Irene lake there are some patches of conglomerate lying directly on the diabase.

Much of the diabase associated with the Keewatin greenstones and porphyries to the southwest of Everett lake occurs in dike form, usually striking north and south. The rock is usually finer-grained than in the larger areas, and the diabasic texture is more prominent.

A thin section of a diabase from the north line of H. F. 204, shows a typical ophitic texture. The plagioclase (labradorite) occurs in rods set in the augite, which is partially altered to green hornblende. Quartz in micrographic intergrowth with feldspar fills the interstices.

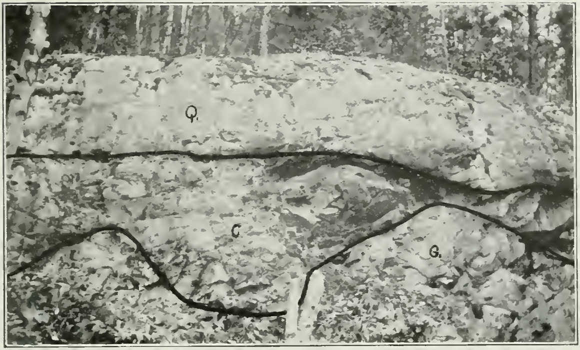
The descriptions of the diabase in Dr. Miller's report on the Cobalt area apply to the diabase of this area, and the reader is referred to that report for an extended description of a number of sections from different localities.

In the vicinity of Lost lake, particularly to the west, there is an extensive development of a reddish phase of the diabase. It is always associated with the normal diabase and in places would appear to shade into this latter rock. It occurs in a number of shades of red and brown, and is at times almost indistinguishable from the normal diabase. Some of the darker varieties have a diabasic texture and the light red varieties are quite granitic in appearance with abundant free quartz. A micropegmatic intergrowth of quartz and feldspar is very prominent in several sections of this acid phase. In composition and appearance much of the more acid portions are very similar to the narrow aplite dikes, which in portions of the area are found


mineralized with native silver. On the east side of Lost lake and on the south line of M. R. 679 this acid phase is prominent. A section of a rather coarse-grained, reddish brown sample is seen to be largely composed of a micrographic intergrowth of quartz and feldspar, which is developed around stout phenocrysts of acid plagioclase. On the outer edge of the intergrowth are grains of quartz. In very minor quantity the ferromagnesian mineral is seen to be chlorite.

At a number of points are dikes of porphyritic diabase with phenocrysts of plagioclase up to two inches in length. A striking example occurs on the north line of E D. 2, to the north of Bloom lake, where in a dark diabasic matrix are thickly studded crystals of light-colored, finely striated plagioclase. It is also seen on the east side line of H. F. 208, and the south line of M. R. 1059, south of Everett lake.

About 200 yards south of Bloom lake and near the creek, the diabase intrudes Laurentian granite. It may be seen intruding Keewatin schist at Cartwright's camp on Everett lake.




Photo—W. F. Battersby.

Contact of Laurentian and Huronian, east shore of Bloom Lake.
(G) granite, (C) angular and rounded fragments of granite, (Q) quartzite.

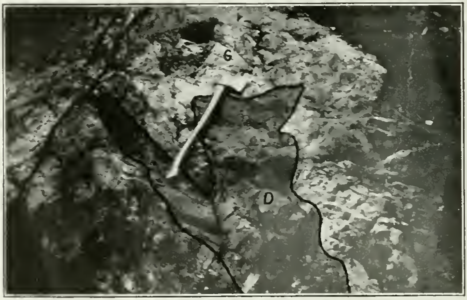

Photo—W. F. Battersby.

Contact of Huronian slate (H) and post-middle Huronian diabase, (D) Bulsh Lake.

### Huronian

The rocks of this formation occur over a considerable part of this area, and consist of greywacké, conglomerate, slate, quartzite and arkose. In the unmapped portion between Bloom and Wigwam lakes and Silver lake these rocks are prominent, as seen along the winter road from Hubert lake to Bloom lake, and the road from Silver lake to Wigwam lake. These rocks are comparatively undisturbed and the prevailing dip is easterly at a low angle. On the east shore of Bulsh lake the slates dip to the south as well as to the east. On the west shore of this lake, in a small area, the slates have been much broken and recemented in a mosaic-like form.

Much of the area between Everett and Miller lakes is a conglomerate, shading into quartzite in places. Along the east side of the Laurentian shown to the north of Everett lake, there is usually a thin strip of conglomerate, which, near Bulsh lake, is overlain to the east by quartzite and slate in ascending order. North of Bloom lake the slates, which strike N. 20° W., are overlain by coarse boulder conglomerate, which has an extensive development to the northeast of the lake and at its outlet.




Photo—W. F. Battersby.

Granite (G) intruded by post-middle Huronian diabase (D) south of Bloom Lake.

The area immediately east of Bloom and Wigwam lakes is largely reddish quartzite and arkose. Farther south, reddish slates are prominent. Medium-grained arkose, of different colors, is seen to the northwest of Calcite lake. At one place translucent quartz and pinkish feldspar are the prominent minerals.

In the vicinity of lake Irene, to the east, the chief rock is reddish banded slate. About one mile east of the northwest corner of Lawson on the west shore of a small lake, the slate is very ferruginous, showing on analysis 7 per cent. of soluble ferric oxide. To the west this passes gradually into a normal slate.

### Laurentian

The formation has a great development to the west of Bloom lake, from the East branch southward to Everett lake. Toward the north the rock is a rather coarse, reddish, hornblende granite. In thin section it is seen to be a hypidiomorphic mixture of quartz, orthoclase, acid plagioclase and green hornblende, with a little sphene, apatite and magnetite as accessory minerals. Toward the south the quartz becomes deficient and the rock passes into a hornblende syenite, which is seen around

Everett lake. Just east of Cartwright's camp on Everett lake the syenite intrudes the banded Keewatin hornblende rocks. There is much intermingling of the two formations and the line of contact is not marked. Both these formations are cut by dikes of later diabase. About a mile and a half south of Miller lake a small area of Laurentian occurs, consisting of a porphyritic syenite with phenocrysts of feldspar. This rock is older than the Huronian, as the quartzite in the vicinity carries fragments of the syenite. In thin section much of the feldspar is in idiomorphic crystals, some of which show a zonal structure due to the regular arrangement of included minerals. The ferromagnesian mineral is green hornblende, and there is a little biotite, partially altered to chlorite. Quartz is present in small grains. Reddish granite occurs in small areas on the east and west shores of Bloom lake, south of the narrows. On the east side it is cut by some narrow dikes of diabase. The narrow band of granite to the east of Bloom lake is overlain by Huronian quartzite.

To the west of Shanty lake a small area of hornblende gneiss is seen.


Photo—W. F. Battersby.

Keewatin (K) intruded by diabase (D) east of Cartwright's camp, Everett Lake.

### Keewatin

The formation is represented for the most part by basic igneous rocks, more or less metamorphosed. They are both massive and schistose. Where schistose or banded, the rocks are always found to be highly tilted, and for this area some of the fine-grained varieties may be thus distinguished from similar rocks in the Huronian, which lie at a comparatively low angle. The schists are often crumpled and folded, and in places pass into more massive varieties.

A somewhat massive rock is seen to the north of Miller lake, and has a greenish weathered surface. A sample of this rock from the south line of R. S. C. 87 shows in thin section to be essentially fibrous and scaly green hornblende. To the east of this lake there is much hornblende and chlorite schist. These older rocks are much intruded by dikes of diabase, which are difficult to distinguish as to age.

To the west of Leroy lake, the greenstone is much altered and has a dull green color and mottled appearance. A section of a rock from the shore shows much chlorite, epidote in grains and veinlets, fibrous hornblende and other secondary minerals. Part

of the rock is schistose. On the north side of a small lake just west of Leroy lake the banded rock has a strike of N. 65° E., and dips 70° N. This schist passes gradually into a massive greenstone.

#### Altered Feldspar Porphyry

About three-quarters of a mile south of Leroy lake some of the rock is an altered porphyry, much sheared and schistose in part. The phenocrysts of plagioclase are much crushed and broken. The ground mass is granular quartz and feldspar. To the west of this occurrence a small belt of very fissile green chlorite schists is seen, cut by small veins of white quartz.

#### Hornblende Schist and Amphibolite

To the southwest of Everett lake there are both schistose and massive Keewatin rocks. Just east of Cartwright's camp the rock is banded, breaking in plates nearly an inch in thickness. A section of the rock shows green fibrous hornblende to be the predominating mineral, with grains of epidote and zoisite and a little chlorite. The rock may be called a hornblende schist. Much of the more massive rock in this area appears to be Keewatin diabase and amphibolite. The rocks are cut by dikes of the later diabase.

#### Porphyry

About one mile southwest of Everett lake there is a considerable development of an ashy gray and white weathering felsitic rock. In some parts it is partially metamorphosed and in others quite massive. At times it is possible to see phenocrysts of quartz in hand specimens. A sample from the south line of R. S. C. 123, under the microscope, shows most of the phenocrysts to be quartz, with corroded and rounded outlines, and partially crushed. Some very ragged outlines of plagioclase are also seen. The ground mass is granular quartz and feldspar with small patches of chlorite Much of the rock is evidently a quartz porphyry.

About one-quarter of a mile to the south a small outcropping of banded iron formation is to be seen.

The porphyries are much cut by dikes of diabase with strike about north and south.

### Working Properties

In the early part of April, 1909, the writer visited the new camp, to see what development had been done at the various properties. Owing to the distance from the railway, much time was spent by the operators in obtaining camp supplies, machinery, etc., over the winter roads from Sellwood and Charlton. Commodious camp buildings have been erected at many of the properties. Almost all the necessary supplies were obtained before the breakup.

The installation of power plants and mining machinery was being proceeded with at several properties. Some mining, consisting in sinking shafts and making open cuts, had been accomplished and at most of the claims visited, some shipping ore had been bagged.

To the west of Gowganda lake all the discoveries examined are in the diabase, which occurs as a narrow band, intruding rocks of the Huronian.

The following is a description of several of the most promising properties in this area:

#### To the Northwest of Miller Lake

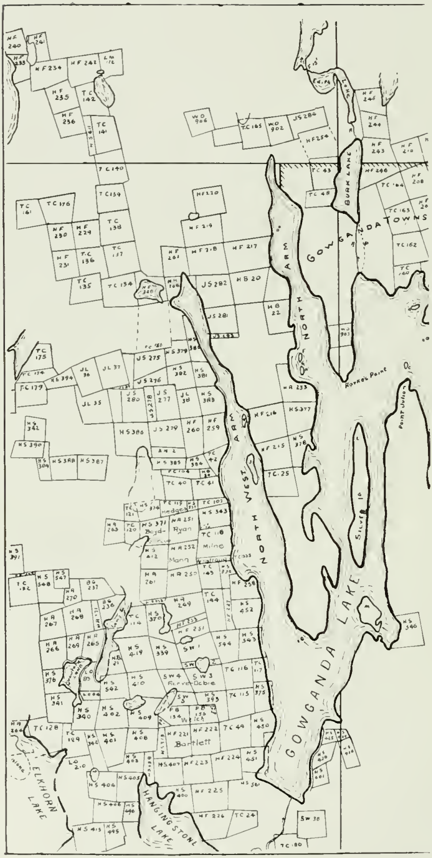
On R. S. C. 82, 83 and 84, known as the Bonsall claims, there are several veins carrying native silver. Most of the work had been done on a vein which crosses the line between 82 and 83. At the main shaft the vein has a strike of N. 42° E. In a pit about 50 feet to the east, it is seen to bend to the north. This vein has been stripped for about 100 feet and at several points showed native silver. On the surface

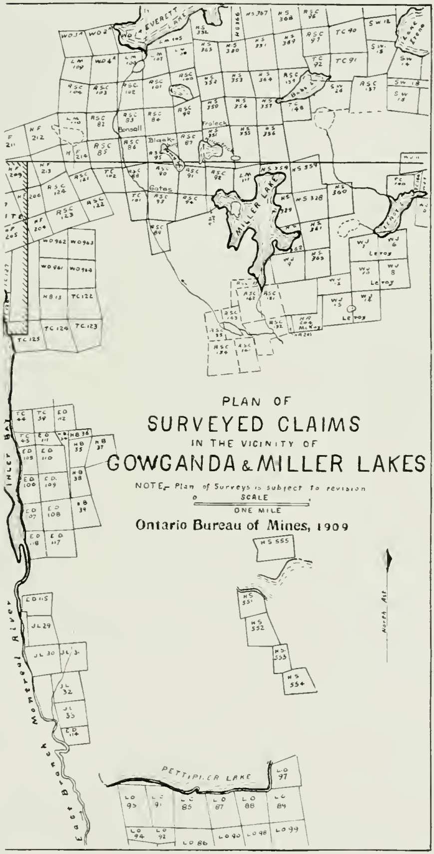
the silver appears to be highly crystallized, and occurs in a black decomposed substance, evidently an oxidation product of cobalt and nickel ores. The vein would average about an inch in width. A shaft, (8 × 5 inside the timbers), had been sunk about 25 feet. The vein dips to the northwest, at a high angle, and the diabase appeared to be much broken. The vein is not uniformly strong, but is broken in places. Some rich ore was showing at the bottom of the shaft at the southwest end. In the pit, which was about 9 feet deep, two veins are seen. The south vein strikes N. 63° E., and widens in places

Open cut Blackburn claim, northwest of Miller Lake, April 1909.

to four inches. The ore is smaltite, niccolite, native bismuth and some native silver. The gangue is chiefly calcite with some quartz. To the north of the pit, the vein showed for a few feet, some very rich ore, consisting of silver and smaltite, about 2½ inches in width. From these veins about 30 sacks of shipping ore (apparently high grade) had been taken.

On R. S. C. 84 a shaft has been sunk about 22 feet on a vein which showed native silver on the surface. The rock at the veins is post-Middle Huronian diabase.


GOWGANDA TOWNS
NORTH ARM
NORTH WEST ARM
GOWGANDA LAKE
BURK LAKE
Silver Is.
Rorke's Point
Point Julian
ELKHORN LAKE
HANGINGSTONE LAKE
Hedges
Boyd-
Ryan
Milne
Mann
Bartlett
Welch
Reeve-Dobie


PLAN OF
SURVEYED CLAIMS
IN THE VICINITY OF
GOWGANDA & MILLER LAKES
NOTE,- Plan of Surveys is subject to revision
SCALE
ONE MILE
Ontario Bureau of Mines, 1909
MILLER LAKE
PETTIPIECE LAKE
INLET BAY
Montreal River
East Branch

On these properties a 4-drill compressor plant was being installed.

On R. S. C. 85 (Blackburn) veins have been found in the conglomerate, as well as in the diabase. An open cut, about 75 feet in length, had been made on the vein in the conglomerate. This vein, with strike N. 43° W. is on the hanging wall. It dips about 70° to the southwest, and would average about an inch in width. In places it widens to from 4 to 6 inches. Native silver has been found at points in the vein, associated with smaltite, and occurs as sheets and nuggets, some of the latter being several inches in length. The conglomerate near the vein is thickly studded with pebbles and boulders.

On a narrow vein in the diabase, toward the west side of the claim, a shaft had been sunk to a depth of about twenty-two feet. About 30 sacks of shipping ore had been taken from the workings on this property.

Two 3-drill compressors were being installed on the property.

On R. S. C. 90, (Gates claim), two shafts had been started on veins showing native silver. These veins or fissures had been trenched for several hundred feet, and occur in the diabase. The silver ore occurs in bunches, associated with smaltite, at points along the vein. The chief gangue is calcite. The east vein has a strike of N. 5° E., and, in the cut for the shaft, appeared to be about 3 inches in width. The other vein to the west strikes N. 25° E. at the shaft. Here it is rather strong and on the foot wall shows a width of about four inches in places. On the hanging wall is another vein of calcite and quartz about 2½ inches in width, showing some silver and smaltite.

Two 50-h.p. boilers and a six-drill compressor were being installed.

On H. S. 350 and 351 (Fraleck and Kilpatrick claims) is a strong smaltite-niccolite vein, which is probably the best defined vein in the camp. At one point there is a width of 13 inches of massive smaltite and niccolite. The fissure narrows in both directions from this widest point. The vein strikes N. 6° E. A twenty-foot shaft had been sunk on the Fraleck claim near the line. An abundance of cobalt and nickel bloom was taken from the surface of the vein. Small crystals of chloanthite are seen in some of the ore.

The rock in the vicinity is conglomerate, but immediately at the vein it has more the appearance of a quartzite. This vein or crack has been trenched for several hundred feet.

#### Properties West of Gowganda Lake

On H. S. 371 ((Boyd-Gordon) more mining had been done than on the other claims. On this property there are several veins, showing silver and smaltite, and with nearly east and west strike across a diabase ridge. A shaft had been sunk 42 feet on what is known as No. 3 vein. This vein strikes N. 85° E. at the shaft. The shaft is a 11×9 two-compartment. Ore was taken from three veins which showed in the shaft. These were not continuously rich in ore or constant in width. An open cut was made on the veins to the west of the shaft, with the following dimensions: Length 54 feet, width 6 feet, and height 17 feet. From these working about ten tons of shipping ore had been sacked. Some of this ore, examined by the writer, appeared to be high grade. One fissure or crack has been traced a distance of 250 feet.

Two 50 h.p. locomotive boilers and a six-drill compressor were being installed.

On H. R. 252 (Mann claim) the main vein is well exposed on the side of a bluff, with strike N. 82° E., and with dip almost vertical. The vein at this point is about 3 inches in width and at places shows a rib of native silver about one inch in width through the centre of it. The gangue has been leached from the surface of the vein, and slabs and nuggets of silver have been obtained quite free from other minerals. The vein appears to be the richest along the face of the bluff. Silver has been obtained at points over a distance of 100 feet. At 50 feet from the bluff a shaft had been sunk to a depth of 25 feet. This shaft was not examined by the writer.

Mining machinery, Boyd-Gordon, Gowganda Lake, April 1909.

Camp at Boyd-Gordon, Gowganda Lake, April 1909.

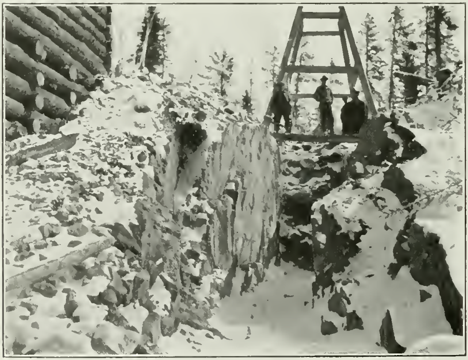
On the north, or Ryan claim, H. R. 251, a shaft had been sunk on what is reported to be a continuation of one of the Boyd-Gordon veins. About 50 sacks of ore had been obtained from the development of these claims.

A small steam plant, consisting of two 25-h.p. boilers and four steam drills, was being installed on this property.

On T. C. 119 (Hedges claim) a vein or fissure with strike N. 58° E., and about one inch in width has been traced several hundred feet. At one point for about ten feet, where it could be seen, the vein showed massive smaltite, in parts of which there was disseminated silver.

On T. C. 118 (Milne claim) the main vein or fissure strikes northwest, and had been traced about 150 feet. It appeared to be richest at the southeast end, where a pit about 8 feet deep had been sunk. In this pit for a few feet the vein is very rich in silver, which showed as a rib in the calcite. Here the vein is from one to two inches in width. In part of the vein the silver is replaced by argentite. At the northwest extension of the vein a shaft had been sunk about 15 feet, and a little silver was found.

On H. S. 335 (Armstrong fraction) the pit where the vein might be seen, was filled with water.



Open cut, Boyd-Gordon, shaft in back ground, April 1909.

On claim H. F. 221, which is one of the Bartlett Mines group, some development had been done. Two 80-h.p. boilers and a 12-drill compressor plant were being installed on the property.

Where the shaft is to be sunk, a cut about 11 feet in length, 7 feet in width and 8 feet in depth had been made. The vein as shown in the cut has a strike of east and west, and could be seen at each end, and at the bottom showed some very high grade ore. In the small space where it was possible to examine the vein it appeared to be rather irregular, occurring as a number of rich shoots. At the bottom of the cut was a shoot about 3 inches in width and about 2 feet in length. Similar shoots or lenses were seen at the ends of the cut. To the southwest of the shaft, about 15 feet, was a rich showing of silver and smaltite exposed for a few feet. Some high grade ore had been sacked.

On S. W. 5, one of the Reeve-Dobie group, very little mining had so far been done. One shaft had been sunk about 15 feet, on a narrow vein, with strike N. 47° W. and showing some native silver and smaltite. To the east of this on another vein, with strike N. 40° W., a pit was down about 6 feet. In the pit were exposed several stringers carrying native silver and smaltite. Some very rich ore had been taken from

No. 1 vein, Mann mines, Gowganda Lake, April 1909.

this pit. About 100 feet above the pit, where the vein was exposed, there was about an inch in width of massive silver and smaltite ore. Below the pit about 200 feet there was exposed, for a few feet, a showing about 3 to 4 inches in width of exceedingly rich ore, from which a sheet of silver about the size of a hand protruded.

A ten-drill compressor plant was on the property, ready for installation.

### On Leroy Lake

To the southwest of Leroy lake considerable development work has been done on the group of Leroy claims. A number of veins has been uncovered, which show in places some native silver. These veins have a strike of N.E. to S.W. and occur in the diabase.

Two shafts were down 50 feet and two others about 25 feet.

### Conclusions

Considering the number of claims, on which high grade silver ore is to be seen, one must admit that this new area has possibilities. Up to the present time, however, there has not been sufficient development work for one to make any definite statements as to the future. The deepest shafts are not down over fifty feet, and no drifting on the

Mining machinery, Reeve-Dobie, Gowganda Lake, April 1909.

veins has been done. Any statements must be confined to the appearance of the shafts, surface indications and the amount of ore already taken out.

At several of the properties, high grade ore was seen in the shafts or pits. The veins are usually narrow, but widen in places to several inches, and in several instances were seen to pinch out in a few feet in depth or in horizontal extension. There is also a tendency for the high grade ore to be segregated in bunches over a few feet. This will necessitate considerable dead work in following tight cracks and lean portions of veins to other rich bunches or shoots.

Costs per ton of ore will be much higher than in the Cobalt camp, and it will take some months' work to prove what profit can be made in working the veins so far discovered.

# South Lorrain Silver Area

By A. G. Burrows

In May, 1908, the writer was instructed by the Provincial Geologist, to examine that portion of the unsurveyed area in the District of Nipissing, which lies south of the township of Lorrain, and north of the Montreal river. For this area, the name "South Lorrain" introduced by the prospectors, has been officially accepted. This area, together with five concessions of Lorrain township, are shown geologically colored on one map sheet. The mapping of Lorrain was completed by Mr. Jas. Bartlett and Mr. R. B. Stewart. The remarks in this report are confined to that portion known as South Lorrain.

This area first attracted attention in December, 1907, when a very promising discovery of native silver was made on a claim now known as the Keeley mine (H. R. 19). A rush followed this discovery, and soon almost the whole area was under staking as mining claims.

"666" on Lake Temiskaming, at the end of the Keeley mine road, July 1908.

The central portion of South Lorrain is about sixteen miles southeast of the town of Cobalt. The camp is most easily reached during the open season, by steamer from Haileybury, from which town it is distant about twenty-two miles. Communication is continued during the winter, over a sleigh road on lake Temiskaming. A government wharf has been constructed just north of the townsite of Sixty-six. From the latter place, a good wagon road extends westerly, by way of Loon lake, a distance of three miles, to the Keeley mine. Another road has been built by the Ontario government, just north of the wharf, and opens up another stretch of country. From these roads, old timber roads or trails may be followed to any part of the area. Lumbering has been carried on for years, so that almost all the pine has been removed. During the past season, serious forest fires destroyed much timber, which would have been suitable for mining purposes.

### Topography

The surface of the country is very rough and hilly, and many small lakes lie in the depressions. The shore line is bold, and the hills rise abruptly from the lake. The

hills and ridges are very conspicuous surface featnres, and are generally found to consist of one geological formation. In consequence, the contacts are usually in the valleys and covered. This fact is well exemplified by a glance at the map, which shows almost all the lakes to lie in contact planes.

In following the road from lake Temiskaming to the Keeley mine, there is almost a continuous ascent. The shaft at the Keeley mine has an elevation of 571 feet and the bridge south of Loon lake an elevation of 323 feet. These elevations are relative to the level of lake Temiskaming on July 15th, 1908, when the water in the lake was higher than the average. The high water elevation of lake Temiskaming is 592 feet above sea level.[1]

Prospectors at Loon Lake, South Lorrain, July 1908.

### Classification of Rocks

In this area, the formations are found to conform to the scheme proposed by Dr. W. G. Miller for the Cobalt area. The writer did not, however, see any unconformity between the quartzite-arkose series and the conglomerate-slate of the Huronian formation.

**GLACIAL AND RECENT**

*Boulder-clay, sand, gravel, etc.*

*Great Unconformity.*

**POST-MIDDLE HURONIAN**

*Diabase.*

*Igneous Contact.*

**HURONIAN**

*Quartzite, arkose, conglomerate, slate, breccia.*

*Great Unconformity.*

**LAURENTIAN**

*Syenite, granite, intrusive into the Keewatin, but not into the Huronian.*

*Igneous Contact.*

**KEEWATIN**

*An igneous complex, chiefly basic igneous rocks together with acid porphyries.*

[1] Dictionary of Altitudes. Department of Interior, Ottawa.

### Glacial and Recent

Over considerable of the area, there is a covering of drift, carrying the usual glacial boulders. On the summits of the ridges, the drift is sometimes very deep. The rock exposures are usually found along the slopes of the hills, where the drift is thinner. On the shore of lake Temiskaming just south of the townsite, the fine-grained green rocks well preserve the glacial striæ. On the main shore, just opposite a small rocky island, the striæ are very striking, and are due south (magnetic). At other points along the shore, there is a little variation to the east or west of south.

In the cutting of the government road just east of H. R. 69, the clay shows a stratified arrangement. Clay hills are seen along the shore of the lake, to the mouth of the Montreal river. Five miles up the river, the clay hills are very high and much cut by deep ravines.

The total distribution of the drift is not shown on the map, but only where the working out of the contacts was seriously interfered with.

Photo—W. B. Macpherson.

Overlooking Lake Temiskaming from hill south of "666," South Lorrain.

### Diabase (Post Middle-Huronian)

This formation has its greatest development in the central portion of the area, extending westward from lake Temiskaming, around the north end of Loon lake, southwest to the east side of Trout lake, and north almost to the Lorrain boundary. In this area it occurs as a very prominent ridge. A smaller area is seen in the northwest portion, where it is associated with the quartzite. In appearance and texture the diabase is very similar to that described in Dr. Miller's Report on the Cobalt Area, Third Edition, and is essentially a quartz-diabase. A thin section of diabase taken from near the contact with the Keewatin on Claim R. L. 471, shows a distinctly ophitic texture. Laths of plagioclase (labradorite) are embedded in a groundmass of augite, which is partially altered to greenish hornblende. Quartz in micrographic intergrowth with feldspar fills the interstices. A few grains of biotite and magnetite are also present. The feldspar is unusually fresh in the section.

A marked occurrence of the diabase is a dike, about five chains in width and traceable for two miles, intruding the quartzite. This may be seen east of G. F. 26,

and a short distance south of the Lorrain boundary. The dike is very fine-grained on either side, and towards the centre has the normal diabase appearance.

There are smaller patches of diabase in the basic Keewatin areas, and these are difficult to distinguish as to age. Some of them are undoubtedly of the same age as the post-Huronian diabase, but, owing to the difficulty of separation from the other rocks, are not shown on the map. A thin section of a diabase associated with the Keewatin on R. L. 468 shows rather fresh plagioclase set in the augite. The latter is greatly altered to green hornblende (uralite). Some grains of quartz are seen in the section.

Along the north line of G. F. 12 there is a reddish granitic rock, which is apparently of the same age as the diabase, and a separation from the same magma.

### Contact with the Huronian

Just north of the Keeley mine road, and west of Loon lake, on G. F. 13, the intrusive diabase (to the west) overlies the Huronian slate, at a high angle.

### Huronian

The predominating rocks are conglomerates and quartzites. The southern part of the area is composed essentially of conglomerates, varying considerably in appearance. The usual variety is that containing subangular and rounded boulders of granite, syenite and greenstone of varied size, in a groundmass of greenish chloritic material At the "Notch" of the Montreal river, the rock is a greywacké conglomerate. A peculiar conglomerate is seen about one-half a mile south of Oxbow lake. Here the boulder inclusions are very few, and the surface shows rounded, pea-like inclusions, harder and darker than the surrounding rock. South of Trout lake on H. R. 163, in a high rounded hill, coarse boulder conglomerate overlies well-banded slate. At the south end of the same lake and to the east, conglomerate and slate overlie the Keewatin, which shows in a bluff, and at a higher level than these in the post-Huronian diabase.

#### Greywacke

Just west of the No. 3 post of H. R. 34 is an outcrop of greywacké which overlies the Keewatin and is overlain to the west by conglomerate.

The greywacké, in thin section, is seen to consist principally of orthoclase, finely twinned plagioclase and calcite, and in subordinate amount, chlorite and quartz. A fragment of greenstone was noticed in the section. This greywacké, which is very deceptive in appearance, was mistaken by prospectors for fine-grained diabase.

#### Quartzite and Arkose

The quartzite and arkose have a great development in the north and west portions of the area. They are varied in color and texture, but are usually rather medium-grained, and the lines of stratification are not very noticeable. The prevailing colors are greenish, grayish, and reddish, and, in this area, the green variety is usually rather friable, whereas the red variety is hard and compact. These varieties seem to pass gradually one into the other on the same ridge. The chief constituents are quartz and feldspar, which are occasionally present in large angular fragments. The green color is due to the presence of sericite, an alteration product of feldspar, and was first noticed in the sea-green quartzites along the shore of lake Temiskaming. When the rock is coarse it is difficult to distinguish in the field from granite, particularly when the red feldspar is present.

In this area the prevailing dip of the Huronian rocks is to the west, varying to the northwest. Near the No. 1 post of L. O. 144, the slates dip to the west at an angle of 20 degrees. One mile west along the Keeley road from lake Temiskaming, and on H. R. 30, the slate and quartzite strike northeast and southwest and dip to the

northwest. In the northwest portion of the area, near the No. 4 post of T. C. 77, the slates and quartzites dip to the southeast.

A breccia *in situ* is seen just east of No. 1 post, R. S. C. 68 It is composed entirely of small angular fragments of greenstone, which is seen in place to the south. This is the lowest portion of the Huronian seen in this area.

West of the Keewatin area, which is shown to the north of Trout lake, the Huronian rocks have been laid down in the following order. The Keewatin is usually overlain by a conglomerate, sometimes slaty. Above this, there is a narrow band of reddish banded slate, rather quartzose toward the upper portion, and overlying the latter there is a large area of quartzites and arkoses, with very little evidence of stratification. The breccia, mentioned above, was only noted at the one point in a very small outcrop.

### Laurentian

The Laurentian is represented in the northeast portion of the area, by a reddish hornblende syenite, in which flesh-colored feldspar and greenish black hornblende are easily recognized. In thin section, in addition to the orthoclase, there is abundant acid plagioclase and microcline. The hornblende is the common green variety, very pleochroic, and shows the distinctive prismatic cleavage and angles of the amphiboles. Quartz is present in smaller grains than the feldspar, and is not prominent enough for a granite. Sphene and magnetite occur as accessory minerals.

Throughout the syenite are rather rounded patches usually darker in color, but which are composed of the same constituents. These are basic secretions from the original magma, formed during the process of cooling. There are also some very small patches which are apparently remnants of a conglomerate formerly overlying the syenite.

Where the syenite comes in contact with the Keewatin to the south, it is found to be younger, enclosing fragments of the greenstone, and occasionally intruding, for some distance, the older rock. On L. O. 153 the syenite is intruded by a very basic trap dike, ten feet wide and striking east and west.

### Keewatin

The rocks of this series occur in several isolated areas. They are usually altered basic igneous rocks, both massive and schistose. The largest exposure extends N. N. E. from Trout lake for two miles. These are, in great part, greenish weathering rocks. The most typical portion is fine-grained, with a slaty appearance when fractured. Throughout the fine-grained rock are bands of coarser varieties, now much altered to amphibolite.

Just south of Loon lake on H. R. 57, the Keewatin is represented by very coarse massive amphibolites, which are highly mineralized with magnetite and iron pyrites.

Quite different in appearance from those above mentioned are the metamorphosed rocks three-quarters of a mile south of Loon lake, and extending from H. R. 114 to lake Temiskaming. These are seen as highly tilted bands, with a general strike a little north of east and almost vertical dip to the north. At the west end of this belt the prominent rock is light colored, weathering to an ashy gray. When freshly broken it has almost a cherty appearance and is exceedingly fine-grained. Locally it is much twisted and crumpled. Thin sections of two samples of this rock showed the original character to be entirely destroyed. The constituents are exceedingly fine-grained and secondary, consisting of quartz, feldspar, chlorite and hornblende or mica.

Folded in the bands of this schistose rock are small dikes of light colored porphyries, showing phenocrysts of reddish feldspar.

A thin section from one of these dikes, near the No. 1 post of H. R. 114, shows phenocrysts of orthoclase and plagioclase, traversed by numerous small veinlets of epidote and hornblende. The groundmass is a granular mixture of feldspar and quartz, with needles of hornblende. Other dikes of porphyry are much fresher in appearance and seem to be younger in age.

On following this belt to the east, the rocks become darker in color and more chloritic. On H. R. 186, is a typical chlorite schist, striking E. N. E., and dipping to the N. N. E. at a high angle. This rock breaks into curved cleavage plates, and is traversed by numerous small torsion cracks, filled with calcite. On H. R. 119 and 120 the schist is intruded by a large dike of white weathering porphyry with colorless phenocrysts of feldspar and quartz.

Small veins of quartz, impregnated with iron pyrites cut the schist in this vicinity. On H. R. 140 one of these carries low values in gold.

There is a belt of somewhat similar Keewatin rocks immediately south of Oxbow lake.


A scene on Lake Temiskaming, showing landing place in South Lorrain.

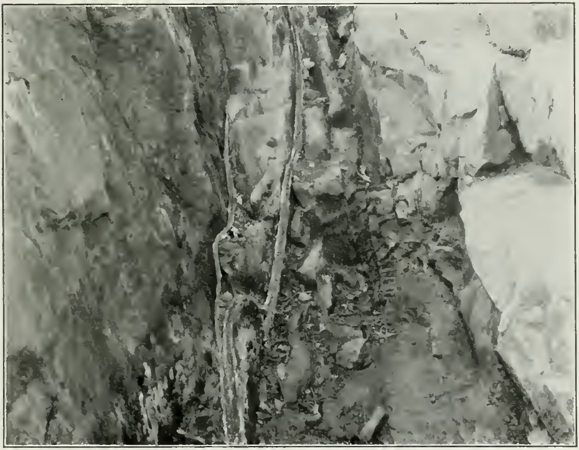
#### Keewatin West of Point Fine

The formation consists principally of rusty, metamorphosed, basic igneous rocks, which may now be classed as amphibolites. In several thin sections, the ferromagnesian mineral is shown to be green secondary hornblende. Just north of No. 1 post of R. L. 469, the amphibolite is much intersected by veinlets of rusty quartz and iron pyrites. These veinlets stand out very strikingly as a ribbed structure from the dark rock. A thin section of the rock shows it to consist of small rods and patches of green hornblende, partly in parallel arrangement, grains of epidote and clear secondary feldspar. The original character of the rock is obliterated. On H. R. 74 much of the rock is very fine-grained and intersected by veinlets of epidote and iron pyrites. A thin section shows the rock to be an alteration of a fine-grained diabase, as the ophitic texture is shown clearly in the rods of altered plagioclase. The albite twinning in the feldspar is occasionally seen. The augite has been altered entirely to green hornblende. A coarser grained rock, outcropping near the No. 1 post of R. L. 465, has resulted from

the alteration of a gabbro. The feldspar is now altered to saussurite minerals, and the pyroxene has changed to a very pleochroic green hornblende, now showing with ragged outline and bent forms. Only occasionally in this belt do the rocks show a schistose structure.

### Discoveries

The principal discoveries have been made near the line of contact of the post-Middle-Huronian diabase and the Keewatin in the area to the north of Trout lake. Along this contact, usually within a quarter of a mile, discoveries of native silver or smaltite have been made in both formations. The Wettlaufer veins are in the diabase, whereas the Keeley veins are in the Keewatin. Toward the north end of this belt the discoveries so far consist of smaltite and niccolite. Small showings of native silver have



A vein showing in pit on the Wettlaufer property, South Lorrain, October 1908.

been found in other isolated areas of the Keewatin or diabase. The writer does not know of any discoveries of native silver in the conglomerate or quartzite, although both these rocks are seen in contact with the post middle-Huronian diabase. In this respect the conglomerate of South Lorrain resembles that around Elk lake, in which no native silver discoveries, as far as is known, have been made.

In the following is a description of a few of the promising veins on some of the properties:—

On the Wettlaufer claim, H. R. 85, there have been found three parallel veins with a strike N. E. and S. W. Of these, the two northerly veins have rich shoots showing native silver in sheet form, while the south vein carries smaltite with low silver values. The veins are narrow, but parts of them attain a width of six inches. Flake silver is shot into the diabase wall rock from one to three inches. The distance

from the north to the south vein is about ninety feet. A shaft is being sunk on the north vein and the intention is to crosscut to the other veins.

At the Keeley mine, H. R. 19, considerable development has been done. At the shaft on the main vein, No. 1, the strike is S. 62° E. The silver occurs in wire form, flake-like sheets and hair-like tufts, associated with smaltite in a gangue of quartz and calcite. Quartz is very prominent in the vein, and is associated with the best values.

The following additional information is supplied by Major Boyd Magee, superintendent of the property. "The main shaft on the original discovery has been sunk to a depth of 133 feet. At the 65-foot level, 220 feet of drifting has been done on the vein, and about 60 tons of shipping ore have been taken out and bagged. The shaft is in the Keewatin formation. Dikes of old diabase have been encountered. At a depth of 130 feet, a crosscut is being driven to catch the main vein which dipped from the shaft at a depth of 78 feet. Associated with the ore is more or less cobaltite. A sulphide of copper and silver, probably stromeyrite, has been fonnd in the No. 1 vein. No. 3 shaft sunk on a cobalt vein has run into shipping ore at a depth of 30 feet."


Horse Whim, Haileybury Silver Mining Co., South Lorrain, 1908.

A sample of massive ore from a vein near the west side line of this property, analyzed by Mr. N. L. Turner, Provincial Assayer, shows it to be smaltite-chloanthite, with the following composition:

| | |
|---|---|
| Cobalt | 10.00% |
| Nickel | 8.16% |
| Arsenic | 68.72 |
| Sulphur | .42% |
| Silver | 8.7 oz. per ton. |

On H. R. 21 there are several calcite veins and one of them has shown on development native silver. This vein is near the east side line and strikes about N. N. E. A shaft has been sunk to a depth of 40 feet. The gangue is calcite, which has a very fine

cryptocrystalline texture, associated in bands with quartz and decomposed material. Leaf silver, in small flakes, has been found across the vein, associated with smaltite, copper pyrites and native bismuth. Minute crystals of chloanthite are scattered through the gangue.

On H. R. 16 (Haileybury Silver Mining Company) the original discoveries were smaltite and niccolite. A sample of the massive ore has the following composition:

| | |
|---|---|
| Cobalt | 15.92% |
| Nickel | 11.18% |
| Arsenic | 60.38% |
| Silver | trace. |

Photo—W. B. Macpherson.

Old timber road, South Lorrain.

The vein has a strike of S. 20° E., and dips 70° to the east.

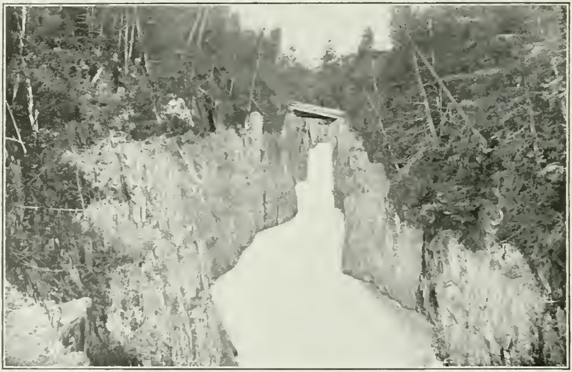
On this vein a shaft has been sunk to a depth of 100 feet, and about 15 tons of massive smaltite have been obtained. Only 17 feet of drifting have been done at this level. The chief vein filling is calcite and decomposed material.

Later a vein showing native silver was discovered on the south half of the claim. The silver is associated with smaltite. A shaft has been sunk on the vein to a depth of 75 feet. At this level drifting was carried 40 feet to the northeast and 40 feet to the southeast. The veins on this property are in the Keewatin.

On H. S. 42 (Forneri claim) there is a vein about 3 inches in width, with strike N. N. E., and occurring in the conglomerate. The vein material is smaltite and copper pyrites in calcite and quartz. A surface sample on assay showed no silver values. A shaft has been sunk to a depth of 75 feet. At 35 feet the vein dipped from the shaft. It is reported that silver values were obtained on assay at 14 feet depth.

On R. L. 471, near the east side line, there is a strong vein of massive smaltite, on which a shaft has been sunk 65 feet. The vein is in the Keewatin.

On H. R. 106, adjoining Trout lake on the northeast, a five by seven shaft has been sunk 50 feet on a calcite vein carrying smaltite.



Geological Survey of Canada, A. E. Barlow.

The Notch, near mouth of Montreal River.

On T. C. 73 there is a shaft down 40 feet on a calcite vein with disseminated smaltite and copper pyrites. These veins have not proved to carry appreciable silver values. The rock is the later diabase.

On H. R. 69 (Maiden claim) there has been extensive development work. Near the east side line, a tunnel has been driven from the base of a hill a distance of 206 feet on a calcite vein. At 100 feet a winze has been sunk to a depth of 60 feet. The vein in places has a width of 12 inches. Smaltite and niccolite are found in bunches in the vein. Low silver values are reported to have been obtained on assay. On vein No. 2 to the west a tunnel has been driven 176 feet. The vein filling is chiefly calcite with smaltite and niccolite in portions of the vein, 5 to 7 inches in width. The veins are in the Keewatin just north of the contact with the later diabase, and strike a little east of north.

On H. R. 14, near the west side line, some native silver has been obtained in a narrow vein in the diabase.

On T. C. 71, east of Loon lake, a tunnel has been driven 100 feet on a strong calcite vein about a foot in width.

At other parts of this area there has been considerable prospecting, consisting of trenching and sinking of small pits and shafts. Calcite veins are the most common type, the calcite being usually associated with more or less quartz, and carrying smaltite and niccolite occasionally. These latter minerals have been found on a number of claims in well-defined veins.

Aplite dikes which are characteristic of many of the silver showings in the township of James and vicinity are of little importance in South Lorrain.

The writer is indebted to several gentlemen associated with this area for information regarding their respective properties. Mr. H. T. Routley, O.L.S., gave the data on elevations mentioned in this report.

Mr. W. B. Macpherson and Mr. W. F. Battersby successively acted as assistants in the field.

# Index.


PAGE.

ALTITUDES, South Lorrain .............. 22
AMPHIBOLITE .............. 12, 26
ANALYSES.
  Ore from Haileybury Mg Co .............. 29
  Smaltite-chloanthite .............. 28
ARKOSE .............. 5, 10, 22, 24
BALSAM, Gowganda area .............. 3
BARTLETT, JAMES .............. 21
BARTLETT MINES .............. 18
BATTERSBY, W. F .............. 1, 31
BELL, DR. ROBERT .............. 3
BIRCH, Gowganda area .............. 3
BISMUTH, Miller lake .............. 13
BLACKBURN CLAIM.
  Character of vein .............. 7
  Discovery .............. 1
  Notes .............. 15
  Open-cut, photo .............. 13
BLOOM LAKE.
  Rocks on, diabase .............. 1, 7, 8
    photos .............. 9, 10
  Route to .............. 3
  Silver on .............. 1
BONSALL CLAIM.
  Discovery .............. 1
  Notes .............. 12, 13
BOYD-GORDON CLAIM.
  Discovery .............. 1
  Notes .............. 16
  Photos .............. 17, 18
BULSH LAKE.
  Rocks on .............. 10
    photo .............. 9
BURROWS, A. G.
  Report by, Gowganda and Miller Lakes silver area .............. 1-20
  Report by, South Lorrain silver area .............. 21-31
CALCITE, S. Lorrain area .............. 26-31
CALCITE LAKE.
  Arkose near .............. 10
  Diabase on .............. 1
  Staking on .............. 2
CANOE ROUTES to Gowganda .............. 3
CARTWRIGHT CAMP, Everett lake .... 8, 11, 12
CHARLTON.
  Depot at, photo .............. 1
  Road north from, photos .............. 4, 5
CHLOANTHITE.
  Analysis .............. 28
  Miller lake .............. 16
CHLORITE-SCHIST .............. 11, 12, 26
COBALT, near Miller lake .............. 16
COBALT, silver at .............. 7
COBALTITE at Keeley mine .............. 28
CONGLOMERATE .............. 5, 10
  Cobalt .............. 7
  Miller lake .............. 16
  S. Lorrain area .............. 22, 24
COPPER PYRITES, S. Lorrain area .............. 30
CORKILL TP .............. 2

PAGE.

DIABASE .............. 5, 22
  Gowganda area .............. 1, 7 8, 12
    photos .............. 10, 11
  S. Lorrain area .............. 23, 24
DOG-TEAM, photo .............. 7
EAST BRANCH, Montreal river .............. 1-3, 10
E. D 2 CLAIM .............. 8
ELK LAKE, Montreal river .............. 1
  Diabase on .............. 7
  Route to Gowganda .............. 2
ERYTHRITE .............. 1
EVERETT LAKE.
  Rocks near .............. 7-11
    Keewatin .............. 12
  Route to .............. 3
FELDSPAR, Calcite lake .............. 10
FLAT RAPID, Montreal river .............. 2
FOREST FIRES.
  Gowganda area .............. 3
  South Lorrain area .............. 21
FORNERI CLAIM .............. 42
FRALECK AND KILPATRICK CLAIM .............. 16
FREIGHT CHARGES .............. 2
GATES CLAIM, discovery .............. 1
    notes .............. 16
GEOLOGY.
  Gowganda area .............. 4-12
  S. Lorrain area .............. 22-26
G. F 12, 13, 26 claims .............. 23, 24
GLACIAL DEPOSITS .............. 23
GLACIAL STRIÆ .............. 23
GNEISS .............. 5
GOLD, S. Lorrain .............. 26
GOWGANDA.
  Established .............. 2
  Photos .............. 1, 6
  Routes to .............. 3
    photos .............. 4, 5
GOWGANDA LAKE.
  Dog-team on, photo .............. 7
  Maps of claims near .............. 14, 15
  Report on district of .............. 1-20
  Road across, photo .............. 5
GRANITE .............. 5, 8
  Bloom lake, photo .............. 9, 10
    reddish .............. 11
  S. Lorrain area .............. 22
GREYWACKÉ .............. 5, 10, 24
HAILEYBURY SILVER MG. CO.
  Notes on vein .............. 29
  Photo of whim .............. 28
HEDGES CLAIM .............. 18
H. F. 204, 208 CLAIMS .............. 8
H. F. 221 CLAIM .............. 18
HORNBLENDE GNEISS .............. 11
HORNBLENDE SCHIST .............. 12
HORNBLENDE SYENITE .............. 10, 25
H. R. 16 CLAIM. *See* Haileybury Silver Mg. Co.
H. R. 19 CLAIM. *See* Keeley claim.
H. R. 21 CLAIM .............. 28

PAGE.
H. R. 30 claim.... 24
H. R. 69 claim.... 30
H. R. 74 claim.... 26
H. R. 85 claim.... 27
H. R. 106 claim.... 30
H. R. 114, 119, 120 claims.... 26
H. R. 140 claim.... 26
H. R. 163 claim.... 24
H. R. 186 claim.... 26
H. R. 251 claim. *See* Ryan claim.
H. R. 252 claim. *See* Mann claim.
H. S. 42 claim.... 30
H. S. 335 claim.... 18
H. S. 350, 351 claims. *See* Fraleck and Kilpatrick claims.
H. S. 371 claim. *See* Boyd-Gordon claim.
Huronian....5, 10, 22-24
*See also* Post-middle Huronian.
Indian chute, Montreal river.... 3
Irene lake....7, 10
Iron pyrites....25, 26
Jack pine, Gowganda area.... 3
Keeley mine.
Altitude.... 22
Discovery.... 21
Notes.... 28
Keewatin formation....5, 8
Gowganda area....11, 12
Silver in.... 7
S. Lorrain area....22-30
Labradorite.... 8
Lady Dufferin lake. *See* Gowganda lake.
Laurentian....5, 8
Bloom lake, photo.... 9
Gowganda Lake area....10, 11
S. Lorrain area....22, 25
Lawson tp....2, 10
Leroy lake.
Mining on.... 20
Rocks on....11, 12
Route to.... 3
Silver near....1, 7
Leroy silver mine.... 1
Lloyd, G. H.... 1
L. O 144 claim.... 24
L. O 153 claim.... 25
Long-point lake.... 3
Loon lake....21-25, 31
Lost lake.
Diabase on....1, 8
Road across, photo.... 5
to; fires near.... 3
McIntosh-McLaughlin claim.... 1
Macpherson, W. B.... 31
Magee, Boyd.... 28
Maiden claim.... 30
Mann claim, discovery.... 1
notes.... 16
photo.... 19
Maps.
Gowganda, Elk lake and Cobalt areas.... Frontis.
Gowganda and Miller lakes, claims near....14, 15
Miller, Dr. W. G....8, 22, 23
Miller lake.
Claims near, map.... 15
notes....12, 13

PAGE
Miller lake.—*Con.*
Laurentian near.... 11
Report on district of....21-31
Route to.... 3
Silver near....1, 7
Milne claim.... 18
Milner tp.... 2
Montreal river.... 1-4
Mountain chute, Montreal river.... 2
M. R. 679 claim.... 8
M. R. 1059 claim.... 8
Niccolite.
Miller lake.... 13
South Lorrain area....29-31
Nickel bloom.... 16
Nichol tp.... 2
Notch, The, Montreal river.
Photo of.... 30
Rocks of.... 24
Obuskong lake.... 3
Oxbow lake.... 24
Parsons, J. L. R..... 3
Petrography.
Amphibolite.... 26
Diabase....8, 23
Granite.... 10
Hornblende-syenite.... 25
Porphyry.... 12
Syenite.... 11
Pine, Gowganda area.... 3
Poplar, Gowganda area.... 3
Pork rapid, Montreal river.... 2
Porphyry....5, 22
Everett lake.... 12
Leroy lake.... 12
Loon lake.... 25
Portage lake.... 3
Post-middle Huronian.... 5
Gowganda Lake area.... 7-9
Photo.... 10
S. Lorrain area....22-24
Quartzite....5, 10, 22
Bloom lake, photo.... 9
S. Lorrain area.... 24
Quartz-porphyry.... 12
Reeve-Dobie claims....1, 19
R. L. 465 claim.... 26
R. L. 468 claim.... 24
R. L. 469 claim.... 26
R. L. 471 claim....23, 30
Routes.
Gowganda area.... 2
photos....4, 5
South Lorrain area.... 21
Routley, H. T..... 31
R. S. C 82-84 claim....12, 13
R. S. C 85 claim. *See* Blackburn claim.
R. S. C 87 claim.... 11
R. S. C 90 claim. *See* Gates claim.
R. S. C 123 claim.... 12
Ryan claim.... 18
Sellwood.... 2
Shanty lake....7, 11
Shining-tree lake.... 2
Sigs lake.... 7
Silver.
Gowganda Lake area....1-20
S. Lorrain area....21-31
Silver lake.... 10
Slate in Lawson tp.... 19

PAGE.
SMALTITE ........ 1
Gowganda Lake area ........18, 19, 27
Miller Lake area ..........7, 13, 16
S. Lorrain area..................29, 31
SMALTITE-CHLOANTHITE, analysis ....... 28
SMYTH.................................. 3
SOUTH LORRAIN.
Diabase in......................... 7
Report on silver in ...............21-31
SPRUCE in Gowganda area.............. 3
STEAMBOAT ROUTES .................... 2
STEWART, R. B......................... 21
STONY CREEK, Montreal river ........... 3
STONY LAKE........................... 3
S.W 5 CLAIM. *See* Reeve-Dobie claims.
SYENITE..... ..............5, 10, 11, 22, 25
T.C 71 CLAIM .......................... 31
T.C 77 CLAIM .................... ..... 25

PAGE.
T.C 118, 119 CLAIMS. .......... 18
TIMBER. *See* Trees.
TEMISKAMING LAKE.
Altitude.......... 22
Glacial deposits...... 23
Photos of portions.... 21, 23, 26
Quartzites .... .... 124
TOPOGRAPHY.
Gowganda Lake area.. . 3, 4
South Lorrain area.. ..21, 22
TREES.
Gowganda Lake area . 3
South Lorrain area.... 21
TROUT LAKE, Montreal river .23, 25
TURNER, N.L. ......... ....... 28
WETTLAUFER CLAIM ....... 27, 28
WIGWAM LAKE. .... .... 1, 7, 10